A Handbook of Appendicitis.....

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A Handbook of Appendicitis

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19215-8
4.11.24

CHICAGO:
G. P. ENGELHARD & COMPANY,
1902.

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PREFACE.

The treatment of appendicitis is still sufficiently new to be worthy of consideration as a special subject.

Its development occurred entirely during my active service in the department of surgery, and being of unusual importance because of the great frequency with which the disease occurs, I have followed its course with special interest.

The following pages contain the conclusions at which I have arrived after a study of much of the literature upon this subject and clinical observations upon a large and varied material.

A. J. Ochsner.

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CONTENTS.

	PAGE
CHAPTER I.	
Introduction and History	9
CHAPTER II.	
Anatomy	15
CHAPTER III.	
Etiology	25
CHAPTER IV.	
Classification	44
CHAPTER V.	
Symptoms	66
CHAPSER VI.	
Differential Diagnosis	81
CHAPTER VII.	
Non-Operative Treatment	91
CHAPTER VIII.	
The Surgical Treatment of Appendicitis	125
CHAPTER IX.	
After-Treatment	160
CHAPTER X.	
Complications of Appendicitis	166
Bibliography	175
Index	177

ILLUSTRATIONS.

PAGE

Fig. I..... 132
The various incisions used in Appendectomy.

Fig. II..... 133
The muscles of the abdomen in relation to the incision.

Fig. III A..... 134
Showing the layers of tissue and McBurney's incision.

Fig. III B..... 135
Showing all the layers of tissue in McBurney's incision, with silk-wormgut suture in place but not tied, and the layer of peritoneum and transversalis fascia already sutured.

Fig. IV..... 138
Showing longitudinal band of cecum and appearance of cecum after peritoneum has been sutured.

Fig. V..... 139
Showing method of clamping appendix and mesentery and placing purse-string suture.

Fig. VI..... 141
Showing manner of burying stump of appendix.

Fig. VII..... 142
Showing interrupted sutures uniting internal oblique muscle.

Fig. VIII..... 143
Showing manner of suturing fascia of external oblique muscle.

Fig. IX..... 146
Showing manner of inserting deep silk-wormgut sutures in closing abdominal incision.

Fig. X..... 148
Showing deep silk-wormgut stitches, peritoneal catgut stitches, uniting rectus abdominis muscle in place.

Fig. XI..... 149
Showing continuous catgut sutures, uniting strong fascia, aponeurosis of external and internal oblique.

Fig. XII..... 152
Showing appendix curled up on lower end of cecum and held in place by adhesions.

Fig. XIII..... 155
Showing incision through fibers of internal oblique muscle in order to gain space.

Fig. XIV..... 157
Showing closure of wound in transversalis fascia and peritoneum by continuous suture.

Fig. XV..... 158
Showing closure of wound in internal oblique muscle with interrupted suture.

CHAPTER I.

INTRODUCTION AND HISTORY.

It is no longer necessary to dwell upon the importance of a consideration of appendicitis, because every one, be he physician, surgeon or layman, has had more or less personal experience with this disease, either in his own family or among his friends, and such experience is usually of so grave a character that one must, thereafter, willingly concede the importance of this subject.

So long as this disease was left to progress undiagnosed, or was mistaken for gastritis, enteritis, idiopathic peritonitis or colitis, it required much forcible argument to draw attention to its practical importance. Fortunately for those who suffer from appendicitis this time has now gone by and in this country, at least, every physician is constantly aware of the fact that he must bear it in mind in examining any patient suffering from intra-abdominal disease.

That appendicitis is of exceedingly frequent occurrence has been proven beyond a doubt by the post-mortem statistics of Richardson,[1] Ferguson,[2] Hawkins,[3] Wallis,[4] and many others, as well as by the testimony of every clinical observer of large experience.

The evident uselessness of the appendix undoubtedly had much to do with the fact that it received so little attention. In a state of health it was plain that the organ need not be considered from the standpoint of physiology, and in the diseased condition the gastric and intestinal symptoms were so prominent that it was again overlooked. Even in the deadhouse the cause of death was so evidently the result of the general peritonitis that, although observers like Rokitanski repeatedly drew attention to the fact that in such cases the appendix was in a necrotic condition, still this was not considered of primary importance until the remarkable work of Fitz[5] brought absolute proof, from a very large clinical and pathological experience, of the fact that hundreds of patients were permitted to die because a gangrenous appendix, which was the cause of the fatal general peritonitis, was permitted to remain in the abdominal cavity unrecognized and undisturbed.

In this paper the necessity of removing the diseased organ was indicated with such vigor, that the subject was at once considered by a number of men whose judgment and surgical skill were well known throughout the country. McBurney[6] and Weir,[7] of New York, Richardson[1] of Boston, Keen[8] and Price[9] of Philadelphia, Murphy[10] of Chicago, and many others, put in practice the

treatment which Fitz[5] had advised, and the results fell nothing short of his expectations.

It is true that appendicitis had been recognized many years before the work of Fitz[5] appeared, but all the observations and publications of an earlier date had not resulted in any practical benefit to the patients who suffered from appendicitis prior to 1890. These earlier publications have only a historical value. They show that there were at all times close observers, and they also show how completely the medical profession in general overlooked structures which had no apparent physiological importance.

The case of perforation of the appendix, described by Mestivier[11] in 1759, seems to be the first on record, but the author, noting the great amount of disturbance about the cecum considered this the primary origin of the disease. This view was maintained by a number of writers during the following century, probably because of the physiological insignificance of the appendix, and because of the fact that all of these cases were seen late. From our own experience it is plain that the earlier we operate, after the beginning of an attack of appendicitis, the more evident it becomes that the disease is always first present in the appendix. It is, consequently, not surprising to find that such excellent observers as Dupuytren,[12] Ferrall,[13] Copeland[14] and Grisolle[15] should

have placed the commencement of the disease in the cecum. The last named author insisted upon opening appendiceal abscesses and, consequently, judged wisely regarding the treatment indicated, although he considered the cecum as being the offending part. All of these authors, and many who followed, described the clinical course of the disease so perfectly that one cannot fail to make a diagnosis of appendicitis from the description given.

Mèlier,[16] in 1827, concludes as a result of a number of observations, that the appendix is frequently the primary cause of quickly fatal peritonitis.

John Burne,[17] as early as 1837, directs the attention to the importance of foreign bodies in the appendix and advises that the abscess formed be opened.

Perforation of the appendix, due to the presence of foreign bodies, had previously been described by Jadelot,[18] 1808, also by Wegeler[19] in 1813, from fatal cases which they had observed. Bottomley,[20] in 1814, reports a case relieved by operation in which a kernel of oats was found.

Perforation of the appendix was observed by Albers in 1838, but he failed to attribute the proper importance to this condition. Nearly twenty years later Lewis[54] developed this fact more

fully, giving a large number of cases in illustration.

In 1843 Voltz[21] and Rokitanski[22] called attention to the pathological conditions found primarily in the appendix. Unfortunately, the latter observer did not seem to examine the appendix in all bodies in his autopsies upon patients who had died from peritonitis, otherwise his enormous material in the celebrated Vienna Hospital would undoubtedly have brought to light many years ago the excessive frequency of the disease.

In 1859 Leudet[23] brought out the same fact in France, as the result of extensive observations.

The cecal origin of peritonitis which had been accepted like so many other theories, because Dupuytren and the French school of surgeons, who were supreme during the first half of the nineteenth century, supported the idea as a result of their observations, received its first absolute denial in 1880 when With[24] demonstrated that the disease is always primarily of appendiceal origin.

Even in the memory of the younger members of the present generation of physicians and surgeons the term typhlitis—inflammation of the cecum—is very familiar as a primary disease.

There can be no doubt whatever in the minds of those who have had frequent opportunity to observe the pathological condition present during the early part of the disease, by having operated

during the first few hours after the beginning of an attack, that the disease always begins primarily in the appendix.

This brings us to the last decade of the nineteenth century, which has produced a number of excellent works upon this subject, among which those by Deaver,[25] Mynter,[26] Fowler[27] and Morris,[28] of this country, Sonnenburg[29] of Germany, Dieulafoy[30] of France and Lennander[31] of Sweden, have been especially valuable in bringing the medical profession to a proper appreciation of this subject. Moreover, there is scarcely a surgeon of any note who is not the author of one or more articles on this subject.

In studying the literature of the past three years, especially, I have encountered nearly one thousand articles in the English, German and French languages alone. It is consequently plain that it is impossible to review this enormous literature in so limited an article as this one must necessarily be, without making it useless for practical purposes.

I will, consequently, give only what I have been able to confirm in my clinical experience, and will dwell especially upon the facts which are important in bringing about methods of treatment which are expected to result in the greatest possible percentage of recovery, in those suffering from this disease.

CHAPTER II.

ANATOMY.

In order to treat appendicitis well, one must constantly bear in mind its anatomical position, and the relative changes that take place in the surrounding organs, in health and in disease.

Generally speaking, the appendix is most frequently found opposite a point half way between the umbilicus and the anterior superior spine of the ilium—McBurney's point. It is important to bear this in mind, primarily, because of its very great importance, which will be discussed fully in speaking of diagnosis.

In the normal condition the appendix extends from the lower end of the cecum, generally in an inward direction, provided its mesentery is of moderate length and thickness. If the latter is especially loose and long it may extend in any direction and undoubtedly changes its position constantly with the change in the position of the patient and the motion of the small intestines. If the mesentery is especially short and thick it is usually drawn upwards at its end so that its direction is more toward the umbilicus.

Treves[32] states, as a result of very careful and extensive studies upon the cadaver, that the ap-

pendix is most constantly found attached a little behind the lower end of the cecum and pointing toward the spleen, and that the only other common position is ascending behind the cecum. Hawkins[3] confirms this from a careful examination of one hundred cadavers.

If the cecum is very movable, which however is only very rarely the case except in cases in which there has at some time been an inflammatory condition of the appendix, the latter may be carried with it to any point in the abdominal cavity, and it may then occupy almost any imaginable position.

The cecum, normally, is in front of or to the inner side of the psoas muscle, extending down to a point nearly even with the middle of Poupart's ligament. Being usually, according to Luschka, entirely covered with peritoneum, it can normally move through a semicircle with a radius of about two inches, and, carrying with it the attachment of the appendix, its origin can normally be found four inches nearer to or further from the median line.

As Deaver[25] has shown, the appendix may take any direction from its origin, consequently it is not safe to take for granted that it must be found in any particular location or direction.

In case of disease the conditions are still more varied, primarily because the appendix may be-

come adherent to any part of the parietal peritoneum which can be reached by any portion of it, or it may become adherent to any of the organs in the abdomen or pelvis. In case it is attached to the small intestines it will move with these. If attached to the liver, the gall bladder or the stomach, it will remain fixed in its abnormal position. If it becomes adherent to the ovary, the Fallopian tube, the uterus or the bladder, or the sigmoid flexure of the colon, it will be fixed in this direction. I have seen it adherent to each one of these organs, a number of times, but it is more likely to be adherent to the cecum, the omentum, the ilium, or to the Fallopian tube than to any of the other organs.

Fowler[27] has found it to the left side of the median line in three cases. Lennander[31] has found it attached to the spleen.

In chronic appendicitis another condition comes into prominence. The adhesions which have been formed as the result of repeated inflammations give rise to obstructions to the passage of gas and feces through the intestines, by causing sharp bends in the ilium or, according to Mayo, by forming a cicatricial narrowing of the ileocecal valve. The pressure which is required to force the intestinal contents on in their course brings about a more or less general condition of enteroptosis, and this will in turn increase the mobility of the cecum

and, consequently, make the position of the appendix still more changeable, unless the inflammation has been sufficient to bring about extensive adhesions fixing the appendix.

There is one guide, however, which always leads the surgeon to the appendix after the abdomen is open, viz., the longitudinal band on the cecum. No matter how much experience a surgeon may have, he is not wise if he does not follow this guide in any operation in which the appendix does not come into view as soon as the abdomen is opened. In acute appendicitis, a week or more after the beginning of an attack, the intestines may be so thoroughly covered with lymph and recent adhesions as to obliterate this landmark.

Even this guide may be misleading in the following manner: In cases of recurrent appendicitis in which a perforation has taken place during one of the attacks, or in which a portion of the appendix has become gangrenous, I have repeatedly found when operating during a subsequent attack, that the longitudinal band leads down to a mass of cicatricial tissue which appears as though it might be all that is left of a gangrenous appendix. From this we may find projecting a club shaped mass of fatty tissue or connective tissue, which is mistaken for the remnant of the mesentery of the appendix but which, in fact, is nothing but a small portion of omentum which assisted in

eliminating the diseased appendix during one of the previous attacks.

Lifting up the cecum one usually finds the appendix adherent to its lower and posterior surface or, occasionally, to the inner surface of the cecum and the lower surface of the ileum, or to both of these structures and to the omentum.

In some of these cases I have found the appendix in the pelvis, being attached to the cecum by only a cicatricial band, which occupied the position in which the appendix had been destroyed by gangrene during a previous attack. Strangely enough, most of the patients in whom I found this condition had previously been operated upon. Some of them came with a history of having had all that was left of a gangrenous appendix removed at a previous operation; others stated that their appendices had entirely sloughed away, while still others had simply been drained during an acute attack. I believe that this condition accounts for practically all cases in which an absent or completely destroyed appendix has been reported.

In male patients it is not very uncommon to find the appendix adherent to the posterior surface of the cecum and sometimes to the ascending colon. In the female I have found this condition much less frequently and usually only in cases with long appendices. This may be accounted for by the presence of the appendicula-ovarian liga-

ment which has been described by Clado,[33] and which has a tendency to direct the appendix downward. This observation does not correspond exactly with Bryant's, who says that the position is the same in the male and the female. It must be remembered, however, that we rarely see the normal appendix in the living male, because we rarely open his abdomen except for the purpose of removing the diseased appendix; while in the female this is not the case.

In this place it is well to refer to three peritoneal fossae described by Lockwood and Rolleston,[34] because they are undoubtedly of great practical importance in bringing about spontaneous recoveries by eliminating the inflamed appendix from the general peritoneal cavity. One of these fossae is formed by the angle between the ileum and the colon—the ileo-colic fossa. The second one is behind the junction of the ileum and cecum and is known as the ileo-cecal fossa. The third one is immediately under the cecum—the subcecal fossa. If the appendix is lodged in any one of these fossae at the time of its inflammation, the conditions are favorable for the formation of a circumscribed peritonitis or, later, a circumscribed abscess which is, of course, likely to rupture into the cecum or into the colon.

The blood supply of the appendix comes through the appendicular artery, which is derived

indirectly from the anastomosis of branches of the superior mesenteric, the right colic, the ileo-colic, and the middle colic arteries. It passes along the free edge of the meso-appendix, giving off branches which pass underneath the peritoneum. In case the meso-appendix is absent, or does not extend to the end of the appendix, the artery usually passes underneath the peritoneal coat of the appendix. According to Clado,[33] there is occasionally quite a marked addition to this blood supply through the appendicula-ovarian ligament, in the female.

The meso-appendix is present in most instances, although it is often difficult to differentiate it from old adhesions in patients who have suffered from repeated attacks of appendicitis. It is rare, however, to find the meso-appendix extending to the end of the appendix in patients suffering from appendicitis. It is much more common to find it cease about the middle of the organ. I believe this fact has a distinct bearing upon the likelihood of the occurrence of gangrene of the appendix which, in my experience, has not frequently been complete except beyond the attachment of the meso-appendix; that is to say, in a part not supplied by blood directly from the meso-appendix. I have frequently observed circumscribed gangrene and perforation between the end of the meso-appendix and the cecum, but complete

sloughing only beyond the end of the latter. It seems that the shorter the meso-appendix the greater the likelihood of gangrene, because of the greater ease with which the blood supply can be completely obstructed.

The nerves supplying the appendix come from the superior mesenteric plexus of the sympathetic, which accounts for the fact that the pain is at first referred to the entire abdomen. As soon as the inflammation has extended beyond the appendix the pain becomes localized, on account of the other nerves affected.

The length of the appendix varies greatly. It is given by Bryant as three and a half inches in the male, and three and one-tenth inches in the female, as the average. He gives as the average diameter in the male one-quarter of an inch, and of the female about one-tenth less. I have repeatedly seen an appendix not longer than one inch, and frequently to exceed six inches and, in a few cases, reaching ten inches in length but, judging from my inspection of nearly one thousand normal appendices in patients upon whom I have operated for other intra-abdominal conditions, I believe that Bryant's figures are correct for normal cases, and that the more nearly normal the appendix is, in regard to its size, the less liable it is to disease.

There seems to be a little confusion concerning

the muscular layers of the appendix, in many of the articles on this subject, because the older authors, following Flint,[55] have overlooked the circular muscle fibres in the study of the appendix. I have studied many sections of appendices and have invariably found both longitudinal and circular muscle fibres, arranged with the same regularity as in other portions of the alimentary canal. Of course, at points at which, during a previous attack of appendicitis, a portion of the wall has been entirely destroyed by gangrene due to thrombosis of the appendicular artery, or by a perforative ulcer and the defect has been repaired by cicatricial tissue, one cannot expect the formation of new muscle fibres and this may account for some of the descriptions one encounters. But in order to secure a proper conception of the normal appendix, one must make the sections from portions which have never suffered from any form of destructive inflammation.

There is no other tube in the human body, so small as the appendix, containing the same amount of muscle fibres.

The lining of the appendix consists of a mucous membrane very similar to that of the large intestine, with the addition of numerous minute patches of lymphatic gland tissue, reminding one of diminutive Peyer's patches. Morris[28] has compared the latter structures with the tonsil, and

thinks that their presence accounts for the very frequent occurrence of infection in this portion of the alimentary tract.

CHAPTER III.

ETIOLOGY.

It seems plain that the mucous lining of the appendix is exposed to the same inflammatory conditions as the other portions of the mucous membrane of the alimentary canal, because of its continuity with the latter. Its anatomical structure is very similar to that of the large intestine, with which it is continuous, having an increased amount of lymphatic gland tissue, making greater the likelihood of its becoming inflamed secondarily. Almost every person has experienced repeated attacks of inflammatory disturbance of the alimentary tract, and it is only likely that during some of these the pathological process has extended into the appendix. The same bacteria are present in both tubes and, consequently, the same infections can take place.

In all parts of the body the severity, or gravity, of an infection depends, to a great extent, upon the lack of drainage. If a surface is so situated that the products of the inflammation do not accumulate, and are not carried on by the lymphatics into the surrounding tissues, the condition will usually not become serious, and after it has subsided the connective tissue, which develops during

the course of repair, will do practically no harm.

Another condition which prevents serious results from localized inflammation is the presence of an abundant blood supply from more than one large artery.

In all of these points, the vermiform appendix is especially weak: First, the inflammatory exudates accumulate in a small tube, which is closed at one end and empties at the other end into the cecum by a comparatively small opening, which is still further decreased in size by any condition of edema which may be present on account of the existing inflammation. Second; any connective tissue deposited will still further limit this lumen and retard the drainage. Third; the appendix is usually supplied by but a single vessel whose impairment must necessarily result seriously to the structure.

Many writers have attributed attacks of appendicitis to the irritation caused by chronic digestive disturbances. It is a fact that a large number of these patients give a history of chronic indigestion but, in my experience, this has occurred almost always in two classes of cases.

First; in those suffering from a certain amount of obstruction to the passage of gas and other intestinal contents through the ileo-cecal valve, due to adhesions resulting from a former severe attack of appendicitis. In these cases the appendix may

be adherent to the ilium causing a more or less acute flexure, or it may be surrounded by a portion of omentum which interferes with the ilium at the point of crossing; or the cecum, the ilium and the appendix may be drawn down into the pelvis by adhesions in this region. In fact, any one of a dozen conditions may be present as a result of adhesions in different locations caused by a former appendicitis. In such cases the subsequent attack of appendicitis is frequently supposed to be caused by the chronic indigestion while, as a matter of fact, the latter is due to a former attack of appendicitis, and the recurrence is due to the presence of infectious material and an abraded surface in what is left of the diseased appendix, in which the normal drainage has been impaired by the cicatricial tissue deposited during the recovery from a former attack. These facts can be established by carefully studying the history, and by noting the pathological conditions at the time of the operation. It will be found that, aside from the evidences of a recent inflammation, there are extensive old adhesions between the appendix and the surrounding structures, and in the appendix itself areas of cicatricial tissue can be demonstrated.

Second; I have found many patients suffering from an acute attack of appendicitis, who had formerly suffered for a longer or shorter time from

indigestion, whose appendices contained fecal concretions which had evidently been present for a long time on account of the contracted condition of the lumen of the appendix at the point of entrance into the cecum. In most of these patients I have found that they have suffered severely from colicky pains in the region of the stomach or the appendix, and that there has always been a marked degree of gaseous distension of the intestines. It seems as if the irritation caused by the passage of gas through the ileocecal valve gave rise to contractions of the appendix upon its contents, and that the pain caused by this produces a spasmodic contraction of the ileocecal valve and consequent obstruction to the passage of intestinal contents and gas from the small into the large intestine.

Of course it is likely that the irritation of the mucous lining of the gastro-intestinal canal, accompanying indigestion, will have a harmful effect upon the mucous lining of the appendix. Consequently, these conditions undoubtedly aggravate each other.

I have made the observation in a number of patients suffering from recurrent attacks of appendicitis, that these came on invariably upon taking a large meal when the patient was physically in an exhausted condition. They could tell beforehand that if they were to eat freely while in this condi-

tion an attack was imminent. If they confined themselves to soup, or some other easily digested food, they would escape for the time.

In vicinities where typhoid fever is endemic I have heard surgeons say that many patients date their attacks back to an incomplete convalescence from this disease. I cannot say from personal experience how much weight should be put upon this theory, but there is no doubt that the lymphoid tissue in the appendix suffers during an attack of typhoid fever.

In children I have always found that an acute attack results after some indiscretion in diet. In fact, in almost every case which has come under my care the attack was primarily diagnosed, not as appendicitis, but as acute gastritis, and only after serious symptoms pointed to a localized peritonitis was the correct diagnosis made.

In every instance the appendix contained fecal concretions; in almost all the appendix was either gangrenous or perforated. These facts, I believe, indicate two things. First; many children who are supposed to suffer from acute gastritis are really suffering from appendicitis, from which they may die without the disease having been properly diagnosed; or they may recover and suffer secondarily from digestive disturbances until they have a recurrence, or until nature eliminates the effects of the primary attack by absorption. I am

certain that in many cases suffering from chronic digestive disturbances, it is well to look for a chronic appendicitis.

Statistics seem to show that more males than females suffer from appendicitis. My own observations seem to disprove this. In the first place, I have treated as many cases of appendicitis in females as in male children; and I have treated a large number of women in whom an appendicitis, both chronic and acute, had been mistaken for a right-sided salpingitis, or pyosalpinx, or ovaritis. Again, I have repeatedly removed a diseased appendix and obtained a permanent cure in patients who had previously had the right ovary and tube removed, for supposed disease of these organs, without obtaining relief.

Of 247 patients which I operated upon at the Augustana Hospital for appendicitis, during the years 1898-1899, 129 were male, 128 female; of the latter 54 had an infection of the appendix and at the same time an involvement of one or both Fallopian tubes. Among these two hundred and forty-seven cases there were thirty children, between the ages of five and fifteen years, all of whom suffered from acute gangrenous or perforative appendicitis. Of these sixteen were girls and fourteen were boys. I believe that this is a very important observation, because it shows that the disease is quite as common in the female as in the

male, contrary to the statements of most authors. I am confident that a very large number of women have suffered from appendicitis in whom the disease has been diagnosed as pyosalpinx, and in whom a comparatively harmless ovary and tube were removed, while the real offender—the appendix—was left in place.

Foreign bodies play a very unimportant part in the etiology of appendicitis, and they are rare in comparison with the number of fecal concretions which form in the lumen of this organ. I have found a pin, a pin worm, a gall stone, and a few times the seeds of small fruits, in the appendix, while I have found many dozens of fecal concretions. The latter are of very great importance because their pressure frequently gives rise to ulceration of the mucous membrane or, if an ulcer exists, their presence prevents its healing. I have many times removed an appendix with an ulcer opposite a fecal concretion at the point of perforation. Sometimes the remaining tissue was so thin that it gave way during the enucleation of the appendix. Again, I have found the ulcer already perforated and the stone in the opening formed or already outside of the appendix.

In a few cases I have found the appendix much distended with fetid pus, when its opening into the cecum was large enough to drain this fluid perfectly, had it not been for the presence of a

fecal concretion which acted like a ball-valve, completely obstructing this passage. In several cases I have found a fecal concretion at the point of escaping from the lumen of the appendix into the cecum when the abdomen was opened, and in three cases I found an appendix with a highly inflamed or gangrenous mucous membrane but no fecal concretion, but in manipulating the cecum I found a concretion which had evidently just been expelled from the appendix.

It seems reasonable to suppose that the relaxation due to the anesthetic had probably overcome a spasm of the proximal end of the appendix, which had previously prevented the escape of the foreign body. These fecal concretions contain an enormous number of micro-organisms, and are therefore capable of furnishing the necessary bacteria for an infection at any time. If this infection reaches the appendicular artery a thrombosis is likely to occur, which must necessarily result in gangrene of the portion of the appendix thus deprived of its blood supply.

There can be no doubt but that the fecal concretions, or enteroliths, which are so frequently found in diseased appendices and which, as has been shown above, are so likely to give rise to serious trouble, form in the lumen of the appendix and do not enter from the cecum, as has been suggested by Talamon and others. This is shown by

their form, which is usually long and oval, conforming to the long, narrow canal of the appendix; also by the fact that usually the portion of the lumen of the appendix between the concretion and the cecum is so narrow that it would be impossible for the concretion to enter from the cecum. The center of the concretion is usually a small amount of fecal matter, and this is surrounded by fatty matter and by various salts arranged in thin layers concentrically around the focus.

In patients suffering from other intra-abdominal diseases, for the relief of which I have opened the abdominal cavity, I have frequently found the appendix quite markedly distended with gas, especially at its distal end, while the cecal end was apparently closed, so that there could be no constant communication between the gas in the appendix and that in the cecum. In these cases, if the appendix was not removed the patient continued to suffer frequently from acute colicky pains indefinitely located in the abdomen, while in cases in which I removed the appendices this pain did not occur.

I believe that, normally, the surfaces of the mucous lining of the appendix should be applied to each other, so as to form a closed tube similar to other tubes in the body when not active, such as the esophagus, the urethra and the ureters, and that when the lumen of the appendix is not closed

it is in a pathological condition which favors the formation of fecal concretions.

Among the predisposing causes we find all conditions which favor an irritation of the mucous lining of the alimentary tract, such as chronic constipation, a chronic catarrhal condition due to vicious habits in eating, taking too much food at one time, taking food too frequently, eating too rapidly without thoroughly masticating the food, being careless in selecting the quality of food. In fact, anything that is likely to upset the digestion is likely to favor an irritation of the mucous lining of the appendix, together with that of the other portions of the alimentary canal.

Cushing,[35] of Baltimore, has found that if only sterilized food and water is taken into the alimentary canal the number of micro-organisms in the alimentary canal is enormously reduced, which would indicate that taking food which has not shortly before been disinfected by cooking, would favor the development of micro-organisms in the alimentary canal and thus the likelihood of the occurrence of appendicitis.

Appendicitis is more common in young and middle-aged persons than in old age. This has been attributed to the fact that the appendix undergoes retrograde changes, being an embryonic structure, and that there is a normal shrinkage and even an obliteration of the lumen of the organ.

Ribbert[36] found in the examination of four hundred cadavers that there was a certain amount of obliteration in one-fourth of the cases. He found that in infants the length of the appendix is one-tenth the length of the large intestine, while in the adult it equals only one-twentieth the length of the latter. This leads him to attribute these changes to a form of retrograde metamorphosis.

My own observations lead me to think that these changes in the structure of the appendix are due to inflammatory conditions which may not have given sufficient symptoms to lead to a proper diagnosis. Other observers have found different percentages of diseased, or atrophied, or obliterated appendices, but everyone who has examined the appendix in many cases suffering from other diseases, must come to the conclusion that a very large proportion of all human beings suffer at some time from an inflammatory condition of the appendix.

Concerning the age of the patient, I have been impressed by one fact, especially in appendicitis in children, namely, that in every case that has come under my observation the patient was first treated for acute gastritis. In all of my cases in children the appendix was gangrenous, either in a circumscribed area, or it was entirely destroyed, and in every instance the diseased appendix contained

enteroliths. About twelve per cent of my patients were between five and fifteen years of age.

It seems entirely just to suppose that in many other similar cases the primary diagnosis was maintained throughout the attack, and that the patients either recovered or died having, in fact, suffered from appendicitis but having been treated throughout the attack for gastritis or enteritis. There is no doubt in my mind but that a previous attack of appendicitis predisposes to a recurrent attack, because the constriction occurring after the first attack is likely to interfere with the drainage of the organ, and surrounding adhesions are likely to cause acute flexion and consequent partial or complete mechanical obstruction.

I have seen a number of patients in whom an attack was brought on by traumatism, but upon questioning the patient closely there was usually a history of a previous attack, the trauma simply setting free some infectious material which had been in a latent state, being practically eliminated from the lymphatic system by the connective tissue surrounding the infected area. Frequently during the past few years patients have applied to accident insurance companies, claiming indemnity on account of appendicitis caused by accidental injury. In such cases it is often difficult to determine whether it is a coincidence or whether the blow actually caused the injury to the appendix.

During the past year I have operated upon three cases in which the history was absolutely clear, and in which there was no attempt or desire to secure damages by the patient, or indemnity from an insurance company. The first case was a boy, thirteen years of age, who had a perforative appendicitis two years previously, and in whom I had drained an abscess and removed some fecal concretions at that time, but owing to the bad general condition I had not tried to remove the appendix. He had been perfectly well ever since this time until the day of his injury, which consisted in falling violently while skating. Immediately he suffered severe pain in the region of the appendix and developed a typical, acute, infectious appendicitis, for the relief of which I operated upon him on the fifth day of the attack, finding a club-shaped appendix which had been perforated near its cecal end during the former attack. It was covered throughout with strong adhesions. The distal end contained a small abscess and there was quite an extensive, acute peritonitis in every direction. The other cases are equally distinct and unquestionable and I have seen many similar ones in former years. Consequently, the importance of traumatism as an exciting cause must be conceded.

Strictures and acute bends due to cicatricial contraction of connective tissue which has

resulted from the inflammatory exudates, which were deposited at a previous attack, undoubtedly have much to do with the production of recurrent attacks because they practically insure the constant presence in the lumen of the appendix of septic material which cannot easily drain into the cecum, and which is ready at any moment to start a new inflammatory condition. Even the slight congestion which accompanies indigestion brought on by eating too freely or eating indigestible food, is often sufficient to bring on a slight attack which subsides as easily as it has come on if the alimentary canal has been emptied and no new food has been taken.

Again, a slight congestion, or edema, may suffice to prevent drainage entirely by completely closing the cecal end of the tube and, with escape impossible, the septic contents of the appendix may accumulate rapidly and even cause a perforation.

Except in very rare cases in which the entire mucous membrane of the appendix is destroyed during the first attack, it is doubtful whether the patient ever completely recovers unless the appendix be removed. It is more likely, from an anatomical and pathological standpoint, and certainly more in accordance with my clinical observations, that the patient usually suffers from disturbance of his digestive apparatus after recovering from

an acute attack of appendicitis. I attribute this chiefly to an obstruction to the passage of gas, and other intestinal contents, through the ileocecal valve. Aside from this, the patient frequently carries about in his appendix a dangerous culture of bacteria which may at any time place his life in peril. Mynter[26] does not deny the possibility of complete recovery from appendicitis without removing the organ, but considers it an exception or almost an impossibility, and I find that this view is shared by a majority of clinical observers of wide experience.

Whatever the predisposing cause may be in any given case, the exciting cause is always some infectious material. The colon bacillus is always present in the lumen of the alimentary canal and, although it is harmless under normal conditions, when these conditions are changed and there is an abrasion, an abnormal condition of the circulation, or a lack of drainage, it becomes at once actively pathogenic. With a perfectly normal peritoneum a considerable quantity of a pure culture of colon bacilli may be injected into the abdominal cavity without causing any harmful effect, as has been shown by the experiments of Ziegler,[37] but if there is any disturbance in the circulation or nutrition of the same peritoneum, the same quantity taken from the same culture will give rise to a dangerous peritonitis.

Aside from the colon bacillus, the staphylococcus pyogenes aureus and albus and the streptococcus pyogenes have been found in the appendix and in appendiceal abscesses. Of these the streptococcus pyogenes is undoubtedly by far the most dangerous. It has frequently been claimed that cases infected with this micro-organism in appendicitis invariably die. Personally, I believe this is true only in case the patient is operated upon after there is diffuse peritonitis. If the operation is performed while the infection is still within the appendix these cases will recover, or, if the surgeon is called too late to do this the patient can still be saved, in most cases, if a method is employed of which I will speak fully in the chapter on treatment. Aside from these micro-organisms, the bacillus of tuberculosis must be borne in mind because, as has been shown especially by Deaver, a tubercular infection of the appendix is not at all of rare occurrence.

Actinomycosis has also been found in the appendix. I have myself operated upon four cases in which this region was the seat of an actinomycosis. It was, however, not possible to determine whether the disease started primarily in the appendix or in the cecum, on account of the extent to which all of the tissues were involved at the time of the operation.

In locations in which typhoid fever is endemic

the typhoid bacillus undoubtedly causes an infection of the appendix at times. I have seen three cases in which an attack of acute appendicitis was followed by a typical attack of typhoid fever, but it was impossible to determine whether the original infection was due to typhoid bacilli, or to other micro-organisms.

In each one of these cases the history was as follows: The patient was in the habit of drinking only sterile water but being ill with acute appendicitis his thirst was intense, and he consequently drank great quantities of water which was taken from the faucet by a friend, the patient being too ill to notice it. All of these cases occurred at a time when the city water contained innumerable typhoid bacilli, during one of our epidemics of typhoid fever. The appendicitis subsided, and the temperature became normal within four to seven days, but at this time a typical attack of typhoid fever commenced, which ran the usual course.

I have, of course, seen many cases in which typhoid fever was diagnosed when appendicitis existed, and at least one case in which it was impossible to differentiate positively between typhoid fever and appendicitis until the Widal blood test had been made. In this case the patient, a young man of twenty-six years, had been apparently well. He had worked hard every day and had attributed his feeling somewhat tired to this fact, but did not

consider himself ill. Suddenly, during the night, he awoke with a very severe pain in the right inguinal region. He showed extreme shock and there was swelling and tenderness over the region of the appendix. He had, however, drank suspicious water which made a perforation of a typhoid ulcer possible. He was in a dying condition when I saw him, five hours after the beginning of the attack, which made the diagnosis of typhoid perforation more likely. Usually the absence of liver dullness and the history will clear up a diagnosis of perforating typhoid ulcer, but in this case we had neither of these aids.

Ultimately it seems clear that appendicitis is invariably due to an infection through some abrasion in the mucous membrane. This is usually caused by the presence of the colon bacillus, frequently in connection with the staphylococcus aureus or albus, occasionally in connection with the streptococcus pyogenes and more rarely the bacillus of tuberculosis, the typhoid bacillus or the ray-fungus. There is no reason why other pathogenic micro-organisms, which give rise to inflammation in other portions of the body, should not cause appendicitis but, so far as I know, those which have been isolated have been considered accidentally present in connection with the colon bacillus, to which was attributed the pathological process.

The statement which Morris[28] makes that "there is but one kind of appendicitis which produces acute symptoms—infective, exudative appendicitis," is undoubtedly true. But it is equally certain that these micro-organisms are constantly found present in perfectly healthy alimentary canals, and perfectly healthy appendices. Consequently, we have here precisely an analogous condition to that which we find on the outer surface of the body. We may bathe our hands in pus or other fluids laden with pathogenic micro-organisms, without experiencing the slightest harm from an infection, because the skin is intact, but change the condition by the presence of a slight abrasion, the prick of a pin or a defective hair follicle, and we at once experience an infection. This may again vary in severity as a result of the natural ability of the cells to resist and destroy the micro-organisms, the direction of the lymph stream (in other words drainage), the conditions of rest, the blood supply of the part affected and, probably the variety and virulence of the micro-organisms.

In infections affecting the appendix very similar conditions obtain, which undoubtedly accounts for the difference in severity of the disease in different patients.

CHAPTER IV.

CLASSIFICATION.

In order to consider this portion of my subject with the greatest possible brevity compatible with thoroughness, I will follow the accompanying classification which was made by Dr. James B. Murphy [10] about six years ago.

A number of other authors have developed carefully arranged classifications, but none of them correspond quite so closely with my own views as this one. Consequently, I have chosen this one in preference to still further complicating the subject by adding a classification of my own:

1. Simple catarrhal appendicitis, accompanying a catarrhal enteritis and without peculiar symptoms, except slight tenderness.

2. Ulceration of mucous membrane without perforation.

   a. Pressure atrophy or ulceration from fecal concretion.

   b. Ulceration with purulent accumulation.

   c. Typhoid ulcer.

   d. Tubercular ulcer.

3. Ulceration with Perforation.

4. Gangrene of mucous membrane, dependent upon mechanical compression by foreign bodies, by

accumulated fluid, or by infection of the wall.

a. Local.

b. General.

5. Gangrene of appendix complete, by compression of base by foreign body, by infection of the wall, or by contortion.

a. With perforation.

b. Without perforation.

6. Infection of peritoneal cavity.

a. Without perforation, local or general.

b. With perforation, local or general.

7. Peritonitis.

a. Local peritonitis without limiting adhesions.

b. Circumscribed abscess.

c. General peritonitis.

1. Simple Catarrhal Appendicitis.

There can be no doubt but that the mucous membrane of the appendix is subject to catarrhal inflammation, precisely in the same manner in which this condition occurs in other mucous membranes, especially as it is continuous with the mucous membrane of the colon which is frequently in a condition of catarrhal inflammation, especially if the patient is suffering from constipation or from diarrhea.

So long as the appendix is free from any form of obstruction, in other words, so long as the

mucus secreted on account of the catarrhal inflammation escapes readily into the cecum, a catarrhal condition here is undoubtedly of no importance whatever. A considerable amount of mucus may accumulate and its expulsion into the cecum may give rise to slight colicky pains, but these will subside readily and there may not even be any tenderness present upon palpation after this slight pain has subsided.

In itself, then, the catarrhal inflammation is quite unimportant. It is, however, entirely different as regards subsequent developments. The mucus present may accumulate and become inspissated, or it may form around a particle of fecal matter, first into a soft mass and as this dries out into a hard concretion or enterolith. This may, in turn, by pressure, cause an abrasion and we have the condition described under the next heading.

2. Ulceration of the Mucous Membrane.

The deeper tissues are now no longer perfectly protected against infection, and it will require only an accidental change in the condition to cause very severe trouble. So long as drainage from this ulcer is perfect it is almost as harmless as if it were outside the body, unless it approaches the peritoneal covering of the appendix wall on account of its increasing depth; but if the edema

about the edges of this ulcer is sufficient to cause an occlusion of the lumen on the cecal side, there is at once an accumulation in the cavity of the appendix which causes pressure against the weakened wall at the point of the ulceration, which may result in perforation.

I have repeatedly observed this condition in which the lumen was closed by edema. It has seemed to me that this condition is most likely to occur if the patient takes an unusually large or an especially indigestible meal.

Again, the enterolith may become wedged in the cecal end of the appendix, acting in the manner of a ball-valve, closing the lumen entirely and giving rise to a condition practically the same as that described above, with precisely as serious results.

It is not rare to find a slight ulcer directly underneath an enterolith, in cases in which there have been most excruciating colicky pains and in which one will find, upon opening the abdomen, a small circumscribed gangrenous area. It seems likely that the irritation of the enterolith upon the abraded surface gives rise to spasmodic contractions of the circular muscles of the appendix, and that we have a condition very similar to that present during the passage of a renal or a biliary calculus, and that the gangrene is due to crushing of the infected tissues at the bottom of the ulcer.

Fowler,[27] and others, claim that this comparison

is not admissible on account of the frequent absence of circular muscular fibers in the appendix, but as I have stated in discussing the anatomy of the appendix, this is a mistaken idea for I have invariably found the circular muscle fibers present, except in circumscribed parts of the walls of appendices which had recovered after a gangrenous destruction of a portion of the organ.

Catarrhal appendicitis must then be looked upon as an exceedingly serious condition in its consequences, because in many cases it will result ultimately in the condition described under the third heading:

3. Ulceration with Perforation.

If the ulceration has progressed slowly to the point of perforation, the latter condition may still be comparatively harmless because the tissues surrounding the appendix, especially the omentum, will have surrounded and consequently isolated the appendix, and the result will be a circumscribed abscess.

The same condition may result in case the perforation occurs suddenly, as will be shown later in discussing methods of treatment, but it may be much more serious because the infectious contents of the distended appendix may be forced into the general peritoneal cavity, causing general peritonitis which will be considered presently.

4. Gangrene of the Mucous Membrane.

Instead of forming an ulcer the catarrhal condition may remain uniform, and in case the enterolith becomes wedged in some narrower portion of the lumen, it may give rise to spasmodic contractions like those described above and the pressure may cause a circumscribed gangrene of the mucous membrane of the appendix.

On the other hand, the cecal end of the lumen may become occluded, and the pressure resulting from the distension of the cavity, thus formed, with septic material may cause a gangrene of the entire mucous lining of the appendix. It is likely that this condition is not very uncommon, but that usually by the time the abdomen is opened the infection, together with the pressure, have caused the gangrene to extend to the other coats of the appendix. My reason for believing this to be the case is based upon the fact that in patients upon whom I have operated very soon after the beginning of the attack, I have found this condition repeatedly, while in patients operated upon later I have found the entire organ gangrenous.

The mucous membrane invariably contains micro-organisms when it is found in this condition, but with these always present in the lumen of the appendix this would undoubtedly be true even if they had nothing whatever to do with

causing the gangrene—in other words, if the gangrene were due entirely to the pressure caused by the accumulating fluid. We know, however, that if the accumulating fluid were sterile it would form a large cyst and there would be no necrosis of the lining of the appendix.

We have an analogous condition in the gangrene of the mucous membrane lining the gall bladder if pathogenic micro-organisms are present, and the formation of a hydrops or cyst of the gall bladder when they are absent, the biliary duct being occluded in both instances.

That this is a serious condition is easily understood when one remembers that the mucous membrane is the only protecting tissue there is between the septic contents and the peritoneal cavity. As soon as this has been destroyed by gangrene it is only a question of a short time when the general peritoneal cavity will be infected.

5. Gangrene of the Appendix.

This condition may occur as described above or it may result from a septic thrombosis of the vessels supplying the appendix. This may occur from the invasion of the vessels by micro-organisms from an ulcer near the vessel affected; or it may result from pressure upon an enterolith in the lumen of the appendix. It is most likely that the presence of an enterolith in the narrow portion

of the lumen of the appendix will cause edema by interfering with the circulation and this will, of course, increase the pressure, etc.

There can be no doubt but that the irritation present frequently gives rise to spasmodic contraction of the circular muscle fibers and that this, in turn, causes the excruciating, colicky, spasmodic pains. This, I believe, is shown by that fact that when gangrene has actually occurred these pains subside and the patient is very comfortable until the subsequent peritonitis gives rise to a pain different entirely in its character.

I have frequently removed an appendix in which this condition was present. A calculus was tightly grasped by the appendix which was congested and edematous throughout, and in which there was a point directly opposite the enterolith which was beginning to become necrotic; there was no pulsation in the appendiceal artery and the veins were enormously distended with blood. I have seen these appendices in various conditions, from this point to absolute necrosis.

I have observed that much depends upon the blood supply of the appendix. If there is a broad, loose mesentery which extends to the tip of the appendix I have never seen the entire appendix in a condition of gangrene, but I have frequently seen a circumscribed area of gangrene usually at a point opposite the attachment of the mesentery,

and I have seen in a few cases a gangrene of the entire appendix for a distance of half an inch, with the portion on either side simply inflamed but not gangrenous. This has also occurred in cases in which this form of a mesentery was present; if, on the other hand, the mestentery is very narrow or if it does not extend to the tip of the appendix, gangrene of a large portion, in fact, usually the entire portion of the appendix which is beyond the attachment of the mesentery and at the same time beyond the end of the enterolith, will become gangrenous and if the mesentery is absent or very narrow and the enterolith is incarcerated near the cecal end of the appendix, the entire organ is likely to become gangrenous.

Any portion of the body which is supplied by but one artery must necessarily become gangrenous if this artery becomes occluded by a thrombus. This accounts for the fact that an appendix may be found gangrenous without having an occluded lumen, nor an ulcerated mucous membrane, nor an enterolith to cause pressure.

In operating upon early cases of appendicitis I have several times found a great amount of disturbance in the appendix, in which an enterolith was about to be forced into the cecum. In three instances the appendix showed an advanced condition of edema while it contained no foreign body, but upon palpating the cecum I found the

enterolith which had been forced into this cavity during the appendiceal colic or, possibly, during the relaxation which accompanied the anesthesia.

Two years ago I observed the following case which shows that gangrene may be imminent but may be averted under favorable conditions: An otherwise strong, healthy, young baker, 23 years of age, who had experienced unimportant colicky pains a few times previously, which he attributed to indigestion, suffered from most excruciating pains in the region of the appendix, at 8 p. m. There was also a diffuse pain extending over the entire abdomen. I saw him at 11 p. m. He lay doubled up in bed screaming at the top of his voice every few minutes when the paroxysms of pain occurred. I had him taken to the hospital at once, gave him four ounces of olive oil, and half a grain of morphia hypodermically. It was about midnight when he arrived so I decided to wait until daylight to perform the operation. The morphin quieted the pain and toward morning he seemed to have recovered entirely from his attack, although he was still tender upon pressure and the muscles over the appendix were tense.

I feared that perforation had taken place although at that time I had never seen a case of perforation so soon after an attack, and regretted the fact that I had not operated in the middle of

the night. Upon opening the abdomen I found the appendix severely congested and entirely surrounded by a delicate film of leucocytes, which filled the space between the appendix and the omentum which surrounded it.

Upon removing the appendix I found a small circumscribed area of mucous membrane, half an inch from its cecal end, which was exceedingly dark and almost gangrenous. This was undoubtedly the point at which the enterolith had been incarcerated which had been permitted to escape into the cecum, by the relaxation of the circular muscle fibers of the appendix subsequent to the administration of the hypodermic injection of morphia. As soon as the enterolith had escaped into the cecum, where it was found, the pain ceased, the edema began to subside, the circulation became re-established and all that was left was the accumulation of leucocytes which had wandered around the appendix to protect the general peritoneal cavity.

It is reasonable to suppose that within a few days the tenderness upon pressure, and the hardness of the abdominal muscles would have subsided and the patient would have been well, temporarily at least, without an operation. On the other hand, had the enterolith remained in its former location for twelve or twenty-four hours longer, a gangrenous appendix would undoubtedly have resulted.

I believe, however, that it is comparatively seldom that relief comes in the manner described in this case, because usually the enterolith is not near enough the cecal end to escape, but it must be recognized as one of the many possible results.

Fowler and others have observed cases in which a contortion of the appendix, in itself, has given rise to gangrene. Undoubtedly the appendiceal artery can be entirely closed in this manner, especially if the appendix is unusually long and the mesentery either absent or especially narrow. I have observed cases in which a twisted appendix, containing at the same time an enterolith, became gangrenous but I have never seen a case in which the contortion alone caused this condition; nevertheless, I believe that the observers mentioned above are undoubtedly correct in their statement.

If the gangrenous appendix is removed early there may be no infection of the surrounding tissues, and the patient may recover precisely as though a normal appendix had been removed. On the other hand, if it is left in the peritoneal cavity it will, usually, within twenty-four or forty-eight hours give rise to peritonitis because it will become permeable to the pathogenic micro-organisms contained in its lumen.

As has been stated before, Ziegler [37] has shown that a certain number of colon bacilli may be placed in the abdominal cavity without causing any dis-

turbance, provided the latter is perfectly normal. This, however, is not the condition here because the micro-organisms are introduced in enormous numbers in the presence of a considerable amount of necrotic tissue.

If the tissues are not disturbed the gangrenous appendix will invariably be surrounded by the omentum, and this by the coils of small intestines, and the infection will be likely to remain circumscribed giving rise to an abscess which may rupture into the cecum, the small intestine or the general peritoneal cavity, or the tissues of the abdominal wall may become edematous and the abscess may open spontaneously through the abdominal wall, with or without the assistance of the surgeon. Or it may follow the fascia of the iliacus muscle and point below Poupart's ligament, or it may follow the connective tissue behind the ascending colon and the liver and open into a bronchus, or give rise to an empyema of the chest.

If, however, there is free peristaltic motion of the small intestines, the omentum may be drawn away from the infected appendix and the infectious material may be distributed throughout the peritoneal cavity, and give rise to an extensive peritonitis.

6. Infection of the Peritoneal Cavity.

Infection of the peritoneal cavity may occur through the unbroken wall of the appendix, as has

been shown experimentally and observed clinically many times.

There is a marked difference in the virulence of the microbes in different patients and under different conditions.

Roger and Josué have demonstrated experimentally that the colon bacillus becomes more virulent when incarcerated in the lumen of the appendix by the closure of its cecal end. This may account, in a measure, for the difference in severity in the course of apparently similar cases.

I believe, however, that much more depends upon the condition of rest or motion of the small intestine. If the small intestine is quiet so that it will not disturb the omentum, I believe that the leucocytes which will accumulate about the inflamed appendix, which has been surrounded by the omentum, will be much more likely to reduce the virulence of the micro-organisms than if the latter were scattered all over the peritoneal cavity. Moreover, micro-organisms of any kind lose rapidly in virulence if they are confined in a small space surrounded by tissues well supplied with blood vessels, and there could scarcely be found in the human body a structure better fitted to bring about this result than the omentum.

I believe that this accounts for the fact that we so frequently find in autopsies, or during laparotomies, appendices which had been destroyed to a

considerable extent by inflammation which had cause any irritation by eating too freely or eating completely subsided, leaving only a greater or less amount of connective tissue to mark its location.

For a number of years I have examined the appendix in each patient upon whom I have performed an abdominal section for the relief of various intra-abdominal conditions, and have frequently found conditions which plainly showed that a long time previously the patient had suffered from a gangrenous appendicitis, when there was absolutely nothing in the history to indicate it. Usually in these cases, if the patient's mother is living she will recall that when a child the patient suffered from inflammation of the bowels, but that this was so long ago it had been entirely forgotten, and the patient has no knowledge of this portion of the history.

7. Peritonitis.

Peritonitis is an inflammation of the peritoneum, which is due to infection. In appendicitis it may come about in any one of the ways enumerated in the above classification. It simply indicates that in some manner one or more of the varieties of pathogenic micro-organisms, described above, have succeeded in passing through the wall of the appendix. This may have occurred mechanically through a perforation. If this has occurred suddenly before the natural protector of

the appendix—the omentum—has had an opportunity to apply itself about the inflamed appendix and become adherent, forming a kind of pouch, the result will depend upon three conditions; first, the amount of septic material expelled; second, the virulence of the micro-organisms present, and, third, the distribution of this material by the motion of the small intestines.

Fortunately for the patient these sudden perforations are not so very numerous. They occasionally occur in the cystic appendix of Talamon,[40] and the appendicitis obliterans of Senn.[41]

In this class of cases the cecal end of the appendix has been entirely occluded, and there has been an accumulation of infectious material in the lumen beyond this point of obliteration. These patients have all experienced more or less severe attacks of appendicitis at some previous time and they are almost never perfectly well and are constantly reminded of the fact that they have a troublesome appendix.

At the present time most of these appendices are removed in the interval between attacks and, consequently, these sudden perforative appendicitis cases resulting in violent peritonitis are not so common as formerly.

Peritonitis always occurs when there is local or general gangrene of the appendix, unless the latter is removed before any of the pathogenic micro-

organisms have escaped through its walls, i. e., in all of these cases which have not been operated upon within the first twenty-four to forty-eight hours after the beginning of an attack.

From the anatomical difference in the different appendices it is clear that it may require much longer for one appendix to become permeable than another. This is especially true regarding the arrangement of the mesentery of the appendix. The wider and longer this is in comparison with the length of the appendix the more resistance will the latter offer to the invasion and transmission of micro-organisms.

Here, again, the severity of the peritonitis will depend upon the three conditions mentioned above. In this case, however, it seems to me that if the small intestines are kept at rest the peritonitis must, necessarily, be limited, because there is always a considerable interval between the time of slight primary infection and the liberation of a considerable amount of septic material.

A third and less frequent infection of the peritoneum occurs by the promotion of localized abscesses through the wall of the appendix, and the infection of the peritoneum from one of these located sub-peritoneally. In other words, we have here metastatic abscesses in the walls of the appendix and infection of the peritoneum from one of these. Hawkins describes this condition very

clearly, and I believe this accounts for the presence of peritonitis in some cases in which the disturbance in the appendix seems scarcely sufficient to account for the inflammation. Fenger describes a condition in which there are numerous minute subserous abscesses, showing that the infection may extend sub-peritoneally.

Another and a very severe form of peritonitis accompanies a condition which is rare, but occurs with such violence that it is not easily forgotten when once observed. It accompanies or results from a septic thrombo-phlebitis of the veins in the mesentery of the appendix and the communicating branches. The last cause for a diffuse peritonitis results from the bursting of a circumscribed abscess into the general peritoneal cavity. I believe that this is practically always avoidable by limiting the motion of the small intestines, as will be shown later, so that they will apply themselves to the omentum which surrounds the localized abscess, and by draining the localized abscess when it appears.

The following experience has taught me that at times it requires but a small amount of force to cause such a rupture.

A patient, fifty-six years of age, came under my observation about the tenth day of his illness. He had a well marked circumscribed abscess in the right inguinal region which was very prominent,

and could be easily outlined by percussion. He was being anesthetized, but struggled slightly as he was almost under the influence of the anesthetic, when suddenly the prominence in his abdomen disappeared. The operation, which followed immediately, demonstrated the rupture of the abscess into the general peritoneal cavity, which had occurred under my observation.

Clinically, I believe it is most convenient to consider appendicitis as acute, chronic and recurrent. The acute attack may subside entirely so far as clinical symptoms are concerned, for a time at least, or it may give rise to a condition which leaves the patient constantly conscious of the fact that he is not perfectly well. He may suffer from the pain in the region of the appendix, which increases whenever there is any digestive disturbance, when there is a little pressure from gas, when he is physically exhausted, or upon making a special exertion; in other words, it may result in a condition of chronic appendicitis.

Pathologically, one will find in these patients the cicatricial tissue which has taken the place of the tissues destroyed by the inflammation during the acute attack, or, one will find more or less extensive adhesions resulting from the destruction of the peritoneum during this attack. The cicatricial tissue may be confined to the mucous lining of the appendix or it may extend through all

of the layers of the appendix, or it may include portions of the surrounding structures which were also destroyed during this attack. If limited to the mucous membrane of the appendix it may give rise to a partial occlusion which will, in itself, only interfere with the drainage of the cavity of the appendix; but it may cause a complete occlusion at any time if the remaining portion of the mucous lining becomes engorged on account of an acute congestion or edema, or if an enterolith becomes wedged into this narrowed point.

I have frequently observed that patients with this form of appendicitis will remain entirely free from unfavorable symptoms if they avoid all irritation of their alimentary canal, but if they cause any irritation by eating too freely or eating indigestible food, especially when physically exhausted, they experience an acute exacerbation at once, especially if at the same time they are constipated. Deaver[25] says: "I am positive that acute indigestion plays a very important role in the etiology of appendicitis." Lange[38] attributes the frequency of appendicitis in this country to bad habits in eating. Many other observers are quite as positive on this point, and to my mind it is perfectly clear that the irritation and consequent congestion caused in this manner brings on recurrent attacks.

In case the principal pathological result of an

acute appendicitis is more or less extensive adhesions of the appendix to the surrounding structures, the clinical symptoms consist simply in those with which we are familiar in patients suffering from chronic indigestion, because the adhesions usually interefere with the normal, uninterrupted passage of gas and food through the alimentary canal.

Deaver attributes the pain and digestive disturbance to compression of branches of the sympathetic plexus included in the cicatricial tissue, but it seems likely to me that the mechanical obstruction of the alimentary canal has much to do with this. To this must be added the fact that during the acute attack of appendicitis the small intestines frequently become so enormously distended that it requires a long time after recovery to regain their normal tone.

It is rare for an acute attack of appendicitis to subside unoperated without leaving one or more of the pathological conditions briefly described above, and it is plain that with these present the patient must be much more liable to a future attack than he was primarily. In fact, many of the best observers with the largest experience think that recurrence in these cases is the rule and complete recovery the rare exception.

An acute appendicitis which remains unoperated must, consequently, as a rule result in death

or in a chronic appendicitis, in which condition it will continue to give rise chiefly to digestive disturbances, unless it results in a recurrent appendicitis on account of the presence of one or more of the conditions described above.

CHAPTER V.

SYMPTOMS.

I believe that the four cardinal symptoms, which have been repeated so often that they are practically known to every physician and surgeon, will suffice in making a diagnosis except in rare cases, provided the physician or surgeon has once become familiar with these symptoms by clinical observation.

It is the actual clinical observation which enables one to make a diagnosis in acute appendicitis rather than a knowledge of the scientific facts involved. In other words, a physician who has observed a number of patients suffering from appendicitis, and has been convinced of the correctness of his diagnosis by seeing the gangrenous appendix removed, is much better able to make a diagnosis independently in the future than he was when he depended upon a description of the symptoms.

1. *Pain.*—As a rule, an acute attack begins with a sudden pain, usually located, more especially, in the vicinity of the umbilicus, but extending over the entire abdomen—more marked, as a rule, in the upper portion of the abdomen, hence,

the patient generally imagines at first that he is suffering from gastritis.

This pain is more or less spasmodic in character subsiding and reappearing in what has been described as a wave-like manner. There is an accumulation of gas, and as this moves about the paroxysms of pain are increased. Usually within twelve or twenty-four hours the pain becomes more and more localized in the right inguinal region. If the patient has received any food by the mouth the paroxysms of pain are more numerous, and the patient describes his condition as one in which he feels that the pain is largely due to the fact that gas is trying to pass some obstruction.

Undoubtedly the congestion in the vicinity of the ileocecal valve extends to this mechanism and it remains closed and prevents the passage of gas. Probably this is the physiological method of securing rest for the inflamed part. I have repeatedly operated upon patients in whom there was complete obstruction to the passage of gas and feces, in whom there was absolutely no cause for this aside from the congestion in the vicinity of the ileocecal valve.

After the first day the patient will almost always locate the pain in the region of the appendix. There is usually still tenderness over the entire abdomen, but the intense pain is localized near a

point half way between the umbilicus and the right anterior superior spine of the ilium—McBurney's point.

2. *Tenderness.*—From the beginning of the attack and throughout the duration of the acute disease there is tenderness upon pressure on the abdomen over the location of the appendix, especially if the pressure is made with one finger. As was stated before, the appendix is not always in the same location, but it is much more commonly underneath McBurney's point than in any other location, consequently, one can usually count upon finding tenderness upon pressure at this point.

3. *Nausea and Vomiting.*—The localized congestion in the vicinity of the ileocecal valve prevents the natural passage of gas and intestinal contents from the ileum into the cecum, and this, in turn, interferes with the physiological process of digestion of the food which has been taken into the stomach. We have, consequently, the same reason for return peristalsis that is present in any other form of mechanical intestinal obstruction. This condition gives rise, primarily, to a feeling of nausea; and, secondarily, if the condition is not changed, the undigested, decomposing food is forced back into the stomach by the persistent return peristalsis and there gives rise to vomiting, precisely as any other similarly nauseating sub-

stance would were it taken into the stomach through the mouth.

That this theory is correct is proven by the fact that if the substance which has accumulated in the stomach in this manner is removed, by washing out the stomach thoroughly and carefully through a stomach tube, the vomiting does not recur unless the same condition is brought about again by placing more food in the stomach, which will, of course, again decompose. It happens occasionally that not all the contents of the small intestine has been washed away by the first gastric lavage, and that this has to be repeated, but this is exceedingly rare unless food is given. Many physicians of my acquaintance have doubted this at first, but all who have carried out this plan have been convinced of its correctness.

This symptom accompanies another symptom which is frequently classified separately, namely, the symptom of intestinal obstruction to the passage of gas and feces. Of course, the nausea and vomiting are the result of the obstruction. Later on in the disease the same symptoms may result from the absorption of products of decomposition through the peritoneum.

4. *Rigidity of the Abdominal Muscles Overlying the Appendix.*—This symptom is of the greatest importance because it frequently enables one to make an early differential diagnosis between

appendicitis, gastritis, salpingitis and biliary or renal colic.

If one has frequently observed patients suffering from appendicitis one can almost always make a positive diagnosis from the above symptoms at the beginning of an attack.

Aside from these symptoms one usually discovers a swelling in the vicinity of the appendix. This is due, at the beginning of an attack, to the placing of the omentum around the diseased organ and the small intestines around the omentum, and to the contraction and consequent thickening of the overlying muscles. Later on there is a still further increase, due to the edema which occurs, and still later to the accumulation of pus if the process progresses to suppuration.

A few times I have found the ileum and cecum filled with fluid, but usually they are empty or filled with gas. In the first case the sound is perfectly flat upon percussion and there may even be fluctuation if the patient has especially thin abdominal walls. It is not possible to make a differential diagnosis between this condition and the presence of an abscess. If the intestines are filled with gas there is resonance upon percussion. If they are entirely empty, which is not a common condition, the percussion sound is dull. I have found the cecum filled with fecal material in only a few cases, consequently I do not believe

that the swelling practically ever depends upon this condition.

The theory of Sahli, and others, that the swelling is always an indication of the presence of pus, has been disproven repeatedly by finding simply an acutely inflamed appendix surrounded by a mass of omentum in cases operated upon a few hours after the beginning of an attack. There can be no doubt but that another day or two would have produced pus, but I am certain that the swelling precedes suppuration.

There is, however, a difference between the swelling to be noticed occasionally at the beginning of an attack, and the definite tumor which accompanies the accumulation of considerable quantities of pus.

Temperature.—The earlier writers laid much stress upon the presence of an elevation of the temperature. It is a fact that unless the patient is operated on early he is very likely to develop a temperature above the normal, which may remain below 100° F. or reach as high as 105° F., but from the standpoint of diagnosis there can be no more treacherous symptom. A very high temperature usually means a grave condition, but a low temperature does not ensure the slightest degree of safety. I believe that more appendicitis patients are lost unnecessarily because the attending physician is not alarmed on account of the

absence of a high temperature, than for any other reason with the possible exception of the pernicious plan of feeding appendicitis patients.

If there is one point in diagnosis which is misleading in appendicitis it is a low temperature.

Pulse.—The pulse is useful as a rule in making an absolutely hopeless prognosis. A pulse which becomes suddenly very rapid, thread-like and uncertain indicates a very grave condition. It must, however, be remembered that the grave condition has usually already advanced to an almost hopeless degree before it is indicated by the pulse; hence, one who depends upon the pulse as a guide to his treatment is very likely to have sad experiences.

If the pulse remains uniform and not above 100 beats to the minute, the patient is usually not in danger at that particular moment but, unfortunately, if one waits for the pulse to give the indication for treatment one is very likely to find that the change in the condition of the pulse comes too late to be of any value to the patient. It is for this reason that one so frequently meets appendicitis patients in a dying condition whose pulse and temperature had been in no way alarming until just before the hopeless condition began.

The tongue is practically always coated, and as the disease progresses it is likely to become

foul, but its appearance has practically no value with reference to diagnosis and prognosis.

Tympanites.—There is distinct difference between the tympanites which occurs at the beginning of an attack and that which occurs later. The tympanites which occurs early I believe is due, as has been stated above, to the physiological effort of the ileocecal valve to secure rest for the diseased part. The gas will be forced on by the peristaltic action of the small intestine until it reaches the ileocecal valve, which remains so closely contracted that none can pass. This causes the primary tympanites, because gas will constantly form and only a portion of it is gulped up from the stomach, the remaining portion increasing the distension.

If the contents of the stomach are now washed away, and no new food is taken so that there can be no further decomposition and, consequently, no new formation of gas, then the tympanites almost invariably subsides and does not reappear unless food is taken before the inflammation in the appendix, and the consequent irritation in the region of the ileocecal valve, has disappeared.

It is quite different with the late tympanites. If the patient receives even small amounts of liquid food during an attack of appendicitis the tympanites will persist, provided the disease is sufficiently severe to prevent the passage of gas freely

through the ileocecal valve. This may in itself distend the intestines to so great an extent that they will lose their tone, and they may even become permeable to the passage of micro-organisms through their walls. They then have the appearance of intestines which have become enormously distended and, in fact, permeable to micro-organisms in strangulated hernia. This form of tympanites may still subside if the contents are removed by gastric lavage and no further food is taken.

If, however, the tympanites is due to a diffuse septic infection of the peritoneal cavity, the condition is much more grave and but rarely subsides. This form of tympanites must be looked upon as one of the gravest symptoms in the course of this disease. It is usually accompanied by another symptom which is equally grave, namely,

The Anxious Pinched Facial Expression.—This must be seen to be appreciated and when once seen it will easily be recognized. It is always accompanied with great restlessness.

Regarding the severe form of tympanites accompanying diffuse peritonitis, I must draw attention to a condition described by Allingham, which is of great importance. A digital, rectal examination will demonstrate that the sigmoid flexure is thoroughly distended with gas.

It frequently happens that the congestion ac-

companying menstruation is sufficient to give rise to an acute, though usually mild, recurrent attack of appendicitis. I have observed patients who suffered severe pain in the region of the appendix during each menstrual period but were quite free from pain at all other times. Upon opening the abdomen I have found enteroliths in the appendix, with a narrowed cecal end or adhesions interfering with the circulation, or a cystic appendix. In many of these cases the Fallopian tubes are involved only secondarily, having been infected with pus, from an appendiceal abscess, which found its way into the vicinity of the fimbriated extremity of the tube. In painful menstruation, which affects the right side more especially, it is always wise to bear in mind the possibility of an appendiceal infection as a cause.

Extreme Contraction of the Muscles of the Abdomen.—Occasionally in very muscular patients the abdomen is absolutely hard and flat from the beginning of an attack of appendicitis. These patients usually vomit violently from the onset of the disease until the alimentary canal is empty, and unless opium is given to overcome the spasmodic condition, or an operation is performed, the patient is usually too ill to again take food. This seems to be an unusual effort on the part of nature to secure rest for the diseased part, and it is not in itself an especially bad symptom,

but indirectly it may be because the patient with this symptom is especially liable to receive a hypodermic injection of morphia, which may make any amount of mischief possible.

In these patients another symptom is also especially marked, although this is usually present in severe cases of appendicitis, namely, costal respiration, which naturally favors the tendency to immobilize the inflamed part.

The Boat-Shaped Abdomen.—Later on in the disease, especially in patients suffering from very diffuse adhesions, the above condition may give rise to strongly sunken abdominal walls, giving rise to the scaphoid abdomen. This is not a grave symptom but it usually indicates an especially tedious convalescence.

Irritability of the Bladder.—If the appendix extends down into the pelvis, or if it becomes adherent directly over the ureter, there is likely to be a more or less marked irritability of the bladder. There may be retention of urine or frequent desire to evacuate the urine, or pain in the region of the bladder. This condition can usually be accounted for by the presence of adhesions.

Flexion of Right Thigh.—In many cases the right thigh is drawn up. In these cases there are adhesions or an abscess implicating the psoas or iliacus muscles. I have occasionally seen patients, especially children, who exhibited this

symptom in whom it was difficult to differentiate between chronic appendicitis and psoas abscess.

Leucocytosis.—Richardson, and others, have made extensive observations which show that there is an increase in the number of leucocytes in the blood in case of perforative appendicitis. This is undoubtedly an interesting fact, but it can hardly be considered of value clinically.

Symptoms of Chronic Appendicitis.

It is very important to be able to recognize the symptoms of chronic appendicitis because, as has been shown before, these frequently result in the most violent form of acute appendicitis. I will describe one of the cases which I had observed for a number of months before his acute attack, and in whom I was able to determine the exact condition present by making an abdominal section. Usually these patients are observed by one physician during the chronic condition and by another, generally a surgeon, at least during a part of the violent acute attack.

This patient, a strong, otherwise healthy young man, complained of indigestion and gaseous distension of the stomach and intestines. A physical examination revealed nothing but a dilatation of the stomach and a slight general enteroptosis. The patient occasionally had very slight colicky pains in the region of the stomach, but I failed to lay

any especial stress upon this. The abdominal walls were thick and I could not determine any pathological condition in the region of the appendix. This patient was repeatedly examined carefully by competent physicians during a period of about two years, but no one could demonstrate the presence of appendiceal disease. There was later a very violent acute attack of appendicitis, with diffuse peritonitis resulting from a perforation due to the presence of an ulcer caused by a fecal concretion the size and shape of a large date seed. The cecal end of the appendix was very much narrowed so that the enterolith could not escape into the cecum. The appendix was universally adherent. It was perforated an inch from the cecal end and the enterolith was found outside of its lumen. I had not seen the patient for two months previous to the acute attack, nor for ten days after the beginning of the acute attack, but his condition had been practically unchanged for two years, except for the fact that the remedies he took from time to time made him somewhat more comfortable temporarily. During this time, however, he was never sick but simply complained, as stated above, of indigestion and gaseous distension and constipation.

I have operated upon many patients suffering from perforated or gangrenous appendicitis who gave a very similar history. I have also operated

upon many cases of chronic appendicitis giving the same history, with the exception that a slightly tender appendix could be palpated, and found upon opening the abdomen a chronic catarrhal condition due to adhesions, or with an enterolith or cicatricial constrictions in the lumen of the appendix.

The above case I mention especially because it had been carefully observed by myself and a number of most excellent physicians, some of whom stand especially high as diagnosticians and practitioners in the field of internal medicine.

This patient undoubtedly carried the fecal concretion for many months in his appendix, and the resulting irritation simply showed itself in these two symptoms.

Chronic Indigestion and Constipation.—These two symptoms I have found present in nearly all cases of chronic appendicitis. In almost all of these cases one can find a tender appendix if one causes a relaxation of the abdominal wall by gently pressing with one hand while one palpates with the other. Edebohls[39] has described a method fully which is usually very satisfactory. In many of these cases the history of an attack during childhood or early life can be elicited which is, of course, of great value in making a diagnosis of chronic appendicitis.

I have frequently observed patients who were

not really ill but whose complexions were bad, the skin never being entirely free from bile pigment and frequently covered with acne, who were suffering from chronic appendicitis. The appendix contained enough septic material and being ulcerated was in condition to give rise to constant absorption, so that they were never entirely free from septic absorption. Of course these patients, as a rule, are constipated and their general condition could be attributed to this, but it has seemed to me that the constipation and the general condition were both due to the chronic appendicitis, because after removing an ulcerated and adherent or constricted appendix, containing enteroliths, or pus, the patient usually gains in weight and general health, his complexion improves and his constipation disappears.

CHAPTER VI.

DIFFERENTIAL DIAGNOSIS.

Acute appendicitis is most commonly mistaken for the following diseases in the order named:

1, Gastritis, or gastric ulcer; 2, enteritis; 3, gall-stone colic; 4, peritonitis, due to infection through the Fallopian tubes in women; 5, extra-uterine pregnancy; 6, renal colic; 7, perforative intestinal ulcer due to typhoid fever, tuberculosis, actinomycosis or carcinoma; 9, intussusception; 10, strangulated hernia; 11, intestinal obstruction due to bands of adhesion.

Other conditions, such as pleurisy, ovarian cyst with twisted pedicle and poisoning, have been mistaken for appendicitis, but these mistakes are so rare that they need scarcely be considered except as curiosities.

It cannot be denied that careful observers who are, at the same time, skilful diagnosticians with an enormous clinical experience have at times not been able positively to make a differential diagnosis, in some special case, between some of these conditions. But, as will be shown later, with the possible exceptions of renal colic and enteritis, both the medical and surgical treatment which is indicated in these severe cases of appendicitis, in

which a positive differential diagnosis is sometimes impossible, is equally applicable for the condition for which it may have been mistaken, so that the patient will not suffer from our inability to make a differential diagnosis in any particular case in which the diagnosis may be especially difficult.

1. Appendicitis can usually be differentiated from gastritis because the greatest point of tenderness on pressure is in the vicinity of the appendix, even though the primary pain seems to be located in the region of the stomach. The tenseness of the abdominal muscles is more marked directly over the seat of the appendix, and the tenderness in the region of the appendix upon deep pressure persists after the general abdominal pain has begun to subside.

In a perforative gastric ulcer the shock is much greater and the abdomen becomes suddenly distended. There is no peristalsis perceptible through the abdominal wall and the liver dulness disappears almost at once.

2. In enteritis both pain and tenderness are diffuse, and if no food is given there is a diminution of the severity of the symptoms over the entire abdomen. The greatest degree of tenderness is located over the center of the abdomen. There is also, usually, a distinct history of a severe irritation either by having the abdomen chilled or by taking an excess of iced drinks, or food which is

likely to cause an irritation of the mucous membrane of the intestines.

3. Attacks of gall-stone colic due to contraction of the gall-bladder upon large gall-stones, whose size prevent them from becoming engaged in the biliary duct and later on in the common duct, are especially likely to be mistaken for appendicitis because of the absence of jaundice. In these cases there is, however, usually a history of dull pain in the region of the liver and under the right shoulder blade. Both pain and tenderness upon pressure are located in the region of the gall bladder, and they persist in this location. A hypodermic injection of morphin will usually make a gall-stone colic of this type subside within half an hour, leaving but little tenderness in any portion of the abdomen and not any over the appendix. In an acute appendicitis, though the pain may subside after the injection of morphin, the tenderness does not subside for fully twelve hours.

It is, however, scarcely safe to depend upon this test unless, at the same time, absolutely no food of any kind is given, because the delay caused might easily be the means of permitting a gangrenous appendix to perforate and cause a dangerous diffuse peritonitis.

4. Peritonitis due to infection through the Fallopian tubes always begins in the lower part of the abdomen. There is usually a distinct his-

tory of an infection. The vaginal vault is always indurated in acute cases, and there is especial tenderness upon pressure in the region of the uterus.

In chronic cases it is frequently very difficult to make a differential diagnosis. It must be remembered that it is not at all rare to find the Fallopian tubes infected secondarily. Neither is it rare for the appendix to become infected secondarily from a pyosalpinx. I have reviewed the appendicitis literature especially with a view to throwing light upon this portion of the subject, and have found that not nearly enough attention has been given to the importance of infection of the Fallopian tubes from the appendix. I am certain that mistakes in diagnosis between these two conditions are not at all rare.

During the past five years surgeons have frequently observed the fact that appendicitis may occur in patients suffering from an inflammatory condition of the ovaries and tubes. In reviewing the appendicitis literature I found a number of articles treating directly of this feature, while it is referred to occasionally in articles discussing the etiology and diagnosis of salpingitis.

Most of these observers speak of the difficulty encountered in making a differential diagnosis. Fowler points out the fact that the proximity of the appendix to the adnexae may confine both objective and subjective symptoms, making differen-

tial diagnosis especially difficult. Sonnenburg[42] discusses the frequency with which the two conditions are confounded, as well as the fact that they may occur together, but does not place appendicitis in a casual relation to inflammation of the adnexae with sufficient emphasis. Dr. Krueger,[43] Sonnenburg's assistant, describes twenty-one cases in which his chief found the appendix and the ovary and tube simultaneously involved, giving an abundance of valuable experience, especially in the direction of diagnosis. Deaver[44] says that if the appendix is very long and overhangs the brim of the pelvis, it may lead to disease of the pelvic contents. He cites a case in which "the right ovary was the seat of an abscess which had evidently been infected by the perforated appendix." Delagénière[45] considers the disease of the appendix secondary to the inflammation of the uterine appendages, in case they occur in the same patient. Borchardt[46] shows that there is a relation between the two conditions.

Bernardbeig[47] reports an interesting case in which an appendicitis due to a foreign body in the organ coexisted with double salpingitis. Polle has written fully on this condition. Barnsby[48] shows that appendicitis may be caused by inflammation of the adnexae. Brooks,[49] as early as 1895, in the discussion of a paper by Robert Morris, stated that he had found both conditions in the same patient.

Richelot[50] reports six cases in which the differential diagnosis was impossible. Dr. Coe,[51] of New York, states that appendicitis occurs as a complication of disease of the adnexae, and that the latter condition is sometimes secondary to the former. Howard Crutcher[52] considers it likely that the appendix has much to do with inflammation of the adnexae. Lennander[31] says that whenever appendicitis results in peritonitis in the iliac fossa and in the pelvis, it is plain that disease of the adnexae may result. Vautrin[53] points out the similarity between appendicitis and pyosalpinx, and their intercurrent effect, but does not state clearly the effect of one upon the other.

In many of these patients in whom there is but a catarrhal appendicitis, possibly complicated with the presence in the appendix of a fecal concretion, the patient is not disturbed except during the period of menstruation, when the temporary congestion is sufficient to increase the irritation in the appendix, as well as in the Fallopian tube, giving rise to a pain of greater or less severity which is usually looked upon as dysmenorrhea due to the presence of salpingitis.

A number of my patients showed this symptom when the operation demonstrated the presence of catarrhal appendicitis, with or without a foreign body in the lumen of the appendix, or there were severe adhesions showing that at some previous

time a portion of the appendix had become gangrenous, or there was partial or complete obliteration of the lumen of the appendix. Whenever the pain in dysmenorrhea is mostly on the right side, especially if it is quite high, it is well to suspect the presence of an appendicitis in connection with the disturbance of the ovary and tube.

In reviewing the histories of the patients upon whom I have operated for appendicitis at the Augustana Hospital during the past two years, I find that in a total of 248 patients the appendix and one or both Fallopian tubes were involved in fifty-six cases, and of these apparently forty-one had primarily an appendicitis from which the infection extended to the Fallopian tube, while in fifteen cases there was primarily a pyosalpinx from which the infection extended to the appendix. In chronic cases who come for examination in the interval between attacks, it is often quite impossible to make a differential diagnosis.

5. In extra-uterine pregnancy the history shows that at least one menstrual period was missed. This, however, would not make it impossible for the attack to be due to appendicitis complicating pregnancy, which is not at all an uncommon condition. I believe that the most reliable symptom is the extreme shock which usually accompanies a ruptured extra-uterine pregnancy.

Moreover, the pain is severest in the lower portion of the abdomen throughout the attack.

If there has been severe hemorrhage, the rapid, thread-like pulse, the blanched appearance of the patient, the sighing, the extreme thirst, all usually make the diagnosis easy. The boggy mass in the cul-de-sac of Douglas, due to the clotting of blood, is also characteristic in a ruptured extra-uterine pregnancy. The cases with but a slight amount of hemorrhage are the ones which are most misleading.

6. In renal colic the pain usually commences in the region of the kidneys and extends downward along the ureter into the scrotum in the male, and the labia majora or the region of the ovaries in the female. There is usually an accompanying irritation of the bladder, and the urine usually contains more or less red blood corpuscles. As was stated before, in case the appendix is adherent to the ureter or the bladder, very similar symptoms may occur, but the urine remains free from blood.

7. In cases of perforative intestinal ulcers, which may be due to typhoid fever, tuberculosis, actinomycosis or carcinoma, the history is of especial importance. If the history is negative the sudden uniform distension of the abdomen with absence of peristalsis, the absence of liver dulness, the severe shock, are the principal symptoms.

However, in the absence of a positive history

one will rarely succeed in making a positive differential diagnosis in these cases. Widal's test is probably best suited to clear up a diagnosis of perforating typhoid ulcer.

8. Volvulus usually follows a definite injury such as a fall. There is frequently a swelling perceptible on the surface of the abdomen, and that is nearly always in the vicinity of the sigmoid flexure or the descending colon, and next to this in the middle of the abdomen. The point of tenderness does not correspond to McBurney's point.

9. Intussusception occurs so rarely in persons more than six years of age that it need hardly be considered in older patients. In children the abdominal walls are usually soft enough to permit palpating the elongated sausage-like mass which is formed by the telescoping of the intestine. The fact that in the vast majority of cases the ileum is invaginated into the cecum makes errors in diagnosis between intussusception and appendicitis not very rare in children.

10. It is always wise to examine the inguinal, femoral and umbilical openings carefully in any severe intra-abdominal disease. If this is done one can usually make a positive differential diagnosis between strangulated hernia and appendicitis.

11. Intestinal obstruction due to bands of ad-

hesion is much more common after surgical operations have been performed for other conditions than in patients who have never had an abdominal section made. For this reason it is usually not so difficult to make a positive diagnosis. If the obstruction is caused by adhesions not resulting from an operation these are usually due to peritonitis from which the patients suffered at some previous time, and in the male these adhesions are almost always the result of an appendicitis.

CHAPTER VII.

NON-OPERATIVE TREATMENT.

Taking into consideration the pathological conditions described, together with the clinical experience, the likelihood of a recurrence after an attack if no operation is performed, and the likelihood of a complete and permanent recovery if the diseased organ is removed under favorable circumstances, we can come to but one conclusion, namely, that if the desired conditions can be obtained the diseased appendix should be removed. Unfortunately these patients are not likely to come under the physician's or surgeon's observation when the conditions are most favorable. There may be no competent surgeon available, consequently the patient's chances for recovery will primarily be very slight if operated upon.

Personally, I can only second the statement made by one of the most experienced men in this country in the surgical treatment of appendicitis, that there are thousands of surgeons who are otherwise competent, i. e., competent to perform the ordinary surgical and gynecological operations, whom he would not think of permitting to open his abdomen in case he personally suffered from an attack of appendicitis. This condition is true

not because it is an especially difficult or dangerous operation, but because it requires an appreciation of the conditions upon which success and failure depend, and this appreciation can be obtained only by observing good methods.

In many of the ordinary surgical operations it is not necessary to follow out the details with any great degree of accuracy, because failure to do this will at most result in confining the patient to bed a little longer than usual or necessary, while in the appendicitis operation it is likely to result in the death of the patient.

This position, when taken in the discussion of appendicitis in medical societies, has frequently given rise to severe criticism because upon its face it looks as though appendicitis operations should be performed only by a few who happen to have acquired especial skill in this class of surgery, possibly at the expense of the lives of a number of patients.

This, however, is not the case. The operation is simple enough if one will but take the pains to learn it, and every town of five thousand inhabitants should have at least one man perfectly competent to do such work. But if there is no such man available then I would say most emphatically that the patient's chances of recovery are many times greater with proper non-surgical treatment than with an operation. Of course, patients have

occasionally recovered, by accident, in the hands of most incompetent surgeons, but the death rate after appendicitis operations in the hands of incompetent surgeons is absolutely frightful.

My experience and personal observation have taught me that physicians and surgeons, as a rule, are absolutely conscientious, and that when they perform this operation, notwithstanding the fact that they themselves know they are incompetent (and they alone must necessarily be their own judges as to their competency), they do this because they have been taught that this is the only right treatment, and that the patient is entitled to an effort on part of the physician or surgeon to save the life which is in danger. I believe that this is extremely bad teaching, and that many hundreds of lives have been sacrified unnecessarily on account of this. I say this because I am confident that with proper non-operative treatment almost all of the cases which are diagnosed reasonably early may be carried through any acute attack, no matter what its character may be.

I would then say, primarily, that no case of appendicitis should be operated upon unless a competent surgeon is available. This, of course, does not apply to cases in which a circumscribed abscess has formed which anyone can open with safety provided he has sufficiently good judgment not to do anything further.

Second, the patient may be in a condition in which he may not be able to bear the shock of an operation. It may be thought that this patient will surely die without an operation, if his disease has advanced to such a stage that he cannot bear the shock, and he should be operated on as a last resort. I will show presently that there need be but a very low mortality among this class of patients if they are treated by a more rational method.

Third, there may not be competent assistants present or available. Of course, if it were absolutely necessary a surgeon might operate entirely without assistance, having a friend of the patient administer the anesthetic, as one would in the case of a strangulated hernia, but this again is not necessary.

Fourth, the surroundings may be especially unsuitable. A competent surgeon can do a clean operation with any surroundings; still, this increases the difficulties and reduces the chances for recovery.

Fifth, the patient may refuse to be operated on or the consulting physician may absolutely object and be supported by the family and friends.

If we can still carry this patient through his diseases safely we will accomplish all that can be expected under the most favorable circumstances.

Non-Operative Methods of Treatment.

Taking then for granted that one or more of the conditions which I have just enumerated, especially the first one, be present, and that we have before us a patient suffering from acute appendicitis which must be treated by a non-operative method, which one of the many methods which have been advocated will give the most favorable results? And how will these results compare with the results obtained were the patient to be treated surgically?

There are two methods which are diametrically opposed to each other, which have usually been recommended by the advocates of internal treatment in appendicitis.

In 1843 Volz initiated the opium treatment. This method resulted so favorably in many cases that it remained in use almost entirely throughout the pre-antiseptic time, and in fact until the remarkable work of Fitz started the surgical treatment. Almost all of the distinguished authors during the half century following the work of Volz give this treatment as the only reliable method. Even Pepper and Osler, of our own time, recommended this treatment strongly and gave special warning against the reckless use of saline cathartics only a few years ago. In the last edition of his book the latter author considers appendicitis a surgical disease.

Since the advent of abdominal surgery many experienced surgeons have found that in cases in which there is danger from peritonitis, the use of saline cathartics without the use of opium in any form in the same patient, gives rise to free drainage and thus reduces the likelihood of accumulation of septic material within the alimentary canal, and consequently they have made use of this form of treatment and, apparently, with fairly favorable results.

Statistics are so varied that it is almost impossible to come to any definite conclusion in comparing the relative results in cases treated by either of these internal methods, as compared with those treated by means of surgical interference; but it seems clear that the mortality is greater in any given number of similar cases treated by either of these internal methods than if treated surgically, provided the statistics of competent surgeons only are considered.

There is, moreover, a decided objection to the use of opium in the treatment of appendicitis, from the fact that the patient's symptoms will appear much less grave than they really are, and the patient may be approaching dissolution before anything in his condition indicates that he is in any great danger.

Then, again, the administration of a dose of opium which is primarily given for the relief of

intra-abdominal pain, before the cause of this pain has been determined positively, may suffice to hide the symptoms so completely that the patient is indeed beyond help before a diagnosis of appendicitis has been made.

It should, consequently, stand as an absolute rule that no opium should be given for the relief of any intra-abdominal pain until a positive diagnosis has been made, even if the treatment of appendicitis by the opium method may be contemplated.

Whichever of these two methods may be employed there are other minor points which may be considered valuable, especially because they increase the comfort of the patient. The application of ice-bags over the appendix has been advocated very strongly by some authors, and undoubtedly it gives a great amount of comfort to many patients. Other authors and clinicians find that hot fomentations and hot poultices are still more valuable, and again others use one or the other of these means according to the stage at which the condition is encountered, using cold in the beginning of the attack and hot if the case is further advanced when first seen.

Leeches are frequently applied over McBurney's point, and patients almost invariably state that their use reduces the pain much more perfectly, and often even more rapidly and permanently,

than the use of opium in any form. It seems almost out of place in our day to even mention the use of leeches in connection with the treatment of appendicitis, because it is only by accident that our ignorance regarding the remarkable comfort their application gives to the patient was disclosed. Personally, I had learned to look upon the faith in the usefulness of leeches as an antiquated, unscientific theory little above the value of a superstition, when I was confronted with the clinical fact that the application of a few leeches by the advice of an old colleague permanently relieved the pain in a patient who had previously been relieved for only a very short time by the use of half-grain doses of morphin given hypodermically. Since that time I have frequently applied leeches, and am convinced that they are of great value in relieving pain.

Almost all authors mention the fact that appendicitis patients should be confined to liquid diet.

For a number of years it has seemed especially difficult to determine the indications for considering any given appendicitis patient properly a surgical or a medical case. Many authorities, among them a number of most distinguished authorities on internal medicine, have considered appendicitis a surgical disease from beginning to end under all conditions. I believe that this is true only if a competent surgeon is available. If this is not the case, then I believe that the plan

of treatment which I will describe will give infinitely better results, and a much smaller mortality.

In order to make the value of this treatment clear I must again draw your attention, first, to the anatomical location of the appendix; second, the physiological functions of the surrounding structures; third, the pathological conditions present during an attack of appendicitis; and fourth, the conditions which favor a satisfactory progress of the disease.

First, the anatomical location of the appendix is such as to make its elimination from the general abdominal cavity comparatively easy, provided the surrounding structures remain at rest for a time.

Second, under a condition of rest the most important physiological function of the surrounding structures, i. e., the cecum, the omentum and the small intestines, consists in surrounding any diseased or injured organ. In case the appendix is in a condition of inflammation, no matter whether this be catarrhal or septic, or whether a fecal concretion is about to be expelled through a perforating ulcer, or whether the appendix be gangrenous, the surrounding structures will at once crowd about this organ and form a perfect barrier against the introduction of septic material into the general peritoneal cavity.

Every surgeon who has frequently operated dur-

ing an acute attack of appendicitis, within a short time of its commencement, has observed this condition. It seems to be the especial physiological business of the omentum to stand guard over the various intra-abdominal organs, to surround them, and to protect the other organs against infection in case of any such danger. In the same manner it seems to be the function of the small intestines to enforce the efforts of the omentum by applying themselves to the latter on every suitable occasion. The condition obtained in this manner is, of course, most favorable, because if it is not disturbed the worst possible result will be a circumscribed abscess.

We must next consider the physiological functions of these organs in case food is taken into the stomach. It is a well known fact that as soon as the slightest amount of food has passed the pylorus continuous peristaltic motion is at once established in the small intestines and, instead of assisting the omentum in preventing the infection of the general peritoneal cavity, this motion will serve to mechanically distribute any septic material with which the intestines may have come in contact. The nausea and vomiting which occur almost invariably in appendicitis indicate that nature rebels against the necessity of removing the small intestines from their condition of rest, in which they can most perfectly protect the general

peritoneal cavity. As a result of this the patient usually objects to taking food. It does not matter how much or how little, or what kind of food is taken, it will always have the effect of starting peristaltic motion of the small intestines.

Another important condition must not be overlooked. It does not matter what quality or quantity of food is taken into the stomach, it will always give rise to a certain amount of gas which must either be expelled through the esophagus by eructation, or it must pass into the colon through the ileo-cecal valve which invariably disturbs the lower end of the colon, and this in turn is likely to cause serious disturbance in the inflamed appendix.

In treating inflammatory conditions in other parts of the body we depend upon rest to a very great extent. We know that any disturbance of an inflamed tissue is certain to materially increase the inflammation, and what is true elsewhere in the body must certainly also be true as regards the appendix.

We have, then, two very excellent reasons for prohibiting the introduction of food into the stomach, and we should bear in mind that this refers to every form of food. Even the lightest kind of liquid or predigested food may suffice to produce a sufficient amount of peristaltic motion to carry infectious material over the entire peri-

toneum, and change what would have resulted in a harmless circumscribed abscess to a fatal general peritonitis. In other words, it frequently requires but a very small amount of food to kill an appendicitis patient.

It does not matter whether the appendix be gangrenous, or whether there be perforative appendicitis, the above conditions will undoubtedly be true.

In the non-operative treatment of appendicitis the condition to be desired consists primarily in obtaining absolute rest for the diseased organ and, secondarily, in isolating the diseased organ by surrounding it with omentum and small intestines for the purpose of favoring resolution of the inflammatory condition, and if this is not possible, substituting a comparatively harmless circumscribed for a very dangerous diffuse peritonitis. These conditions can be accomplished by prohibiting the introduction of every kind of food into the stomach.

So far, the subject has been considered only upon theoretical grounds, but the conclusions are borne out absolutely by clinical observations covering a very large number of cases.

It does not matter whether the patient suffers from catarrhal appendicitis, with or without a foreign body in the appendix, or whether the appendix be gangrenous or perforated, he will almost

invariably recover if from the beginning of the disease absolutely no food is given by mouth. It is, however, to be borne in mind that this does not mean that the patient is to receive a little milk, a little gruel, a little soup, or a little of any other kind of food by mouth—it means that he is to receive absolutely no food by mouth.

This theory is further borne out by the results of the well known opium treatment, which accomplished its results in the following manner: It reduced peristalsis and thus favored a similar condition to that which we obtain by prohibiting food. It also caused an apathy for food and thus unintentionally the patient was protected against his greatest danger.

This form of treatment might be objected to, because the diagnosis cannot always be made positively during the very beginning of the attack. To this I would respond that the other conditions which might be mistaken for appendicitis would also be best treated in this manner. What better treatment could be suggested for gastritis, enteritis, salpingitis, or for peritonitis, due to the threatening perforation of a gastric or an intestinal ulcer?

Even if the patient were suffering from a renal or biliary colic, or an extra-uterine pregnancy, no harm could come from this form of treatment.

Of course, this treatment will not protect the

patient against a recurrence of the disease, nor against the very troublesome digestive disturbances due to adhesions following appendicitis, but it will carry the patient safely over an acute attack of appendicitis. The patient's strength is maintained by administering non-irritating nutrient enemata every three to six hours, which should not exceed four ounces at a time. Usually water can be taken by mouth, but in case this causes any disturbance by giving rise to peristalsis or vomiting, it can be administered by enemata.

I have found the various predigested foods which are in the market much more useful for rectal feeding than the usual nutrient enemata consisting of peptonized milk and egg. Moreover, these foods are generally much less irritating. One-half to one ounce of any of the reliable predigested foods in the market, dissolved in three to four ounces of normal salt solution and administered through a rectal tube, which has been inserted a distance of four to ten inches, every three to six hours, will overcome the feeling of hunger to a great extent, and patients will not suffer greatly even if it is necessary to continue the exclusive rectal alimentation for three or four weeks, although it is almost never necessary to continue this treatment so long.

If the patient is nauseated it is always wise to spray the pharynx with a 2-per-cent solution

of cocain, and then to wash out whatever mucus and undigested food may be in the stomach through a stomach tube. It is surprising often to find a great quantity of decomposing material in a patient's stomach after he has apparently vomited so much that it seems impossible to find any more.

I have often seen a patient's temperature fall two or three degrees within a few hours after the gastric lavage was employed, and a corresponding improvement in the condition of his pulse. It is plain that the same amount of decomposing substance would cause severe sickness in an otherwise healthy person were he to take it into his stomach. It would probably give rise to a severe diarrhea and vomiting, and the person's alimentary tract would rid itself of its disagreeable and poisonous burden very rapidly, but with the presence of an inflamed appendix the ileo-cecal valve is closed and the only relief must come from vomiting. Frequently, this in itself is painful, and while more and more substance regurgitates from the intestines into the stomach, the latter is able to throw off but a portion of this, hence the accumulation.

If, however, this is removed carefully by means of gastric lavage, the contents of the small intestines will usually regurgitate into the stomach while the lavage is in progress, and it is rarely necessary to repeat this, because both the nausea

and vomiting are likely to disappear after the first washing out, and almost invariably after the second if this becomes at all necessary.

If food is given, however, even in small quantities, the conditions are changed at once. The additional food will again decompose, and this will again give rise to nausea and vomiting. This, then, would be another important reason for prohibiting the administration of food absolutely. The food which is given by mouth does no good, because it does not digest, but decomposes, and the patient absorbs the products of decomposition instead of the products of digestion.

Aside from the extremely dangerous irritation caused by producing peristalsis, feeding by mouth causes a further irritation by inducing nausea and vomiting.

The pain in appendicitis subsides very soon after the feeding by mouth is entirely prohibited, because it depends primarily upon three conditions: first, the spasmodic contraction of the muscles of the appendix upon some fecal concretion or other contents of the appendix; second, upon the irritation caused by the attempt of passage of gas or feces through the ileo-cecal valve, and third, upon the friction of the inflamed intestines upon each other.

I believe that frequently the spasmodic contractions of the appendix are started by the irritation

due to the passage, or the attempt at passage, of gas through the ileo-cecal valve. Indeed, I am convinced of this fact, because I have repeatedly found a fecal concretion in an appendix in which these pains had existed so long as the patient was taking food, and in which they had subsided as soon as exclusive rectal alimentation was employed.

The pain of which patients suffering from appendicitis complain, and which they describe as being due to the gas which is trying to pass, also subsides in a short time if absolutely nothing is given by mouth. The same is true of the pain which is due to the peristaltic motion of the small intestines, and that which is due to the great distension of the intestines with gas. We have here precisely the same result that we have in placing an inflamed joint at rest by applying some means of fixation, or by applying a bandage over an inflamed eye to prevent the pain which is due to the motion of the eyeballs and eyelids.

The relief is so rapid and so permanent that one is often tempted to doubt the correctness of the diagnosis, and in this fact lies a very great danger, for it has happened many times that some wise member of the patient's family has considered his judgment of sufficient value to doubt the diagnosis and to feed the patient because it seemed foolish to starve a well man, only to find a diffuse peri-

tonitis develop within a few hours as the result of his folly.

This fact is especially true if this form of treatment is employed soon after the beginning of an attack, because the appendix is so completely eliminated from the general peritoneal cavity within a few hours that a patient with a gangrenous or a perforated appendix frequently appears to be almost perfectly well on the second or third day after the beginning of the treatment. This is contrary to the idea of most authors. McBurney, for instance, says, speaking of gangrenous appendicitis, that "recovery from such an attack without operation is inconceivable," and many other authors are quite as positive on this point.

That this theory is not correct I have demonstrated many times by operating upon these patients at various intervals after such an attack, and have shown that during the attack the appendix was indeed gangrenous. As an illustration of this I will refer to the history of Case No. VI., in which a perforation of the appendix had undoubtedly taken place some ten hours before the patient entered the hospital. This was demonstrated at the operation which took place twelve days later, at which time the perforation in the appendix was demonstrated. An enterolith was found in a small circumscribed abscess outside of the appendix, and

between this and the surrounding tissues, as shown in the history, and still with the treatment described above this patient's condition, which was exceedingly precarious at the time he entered the hospital, became so nearly normal that within three days from this time it would have been impossible to convince anyone who had not seen the patient during the severity of the attack that a perforation had really taken place, and that the patient had been in a dangerous condition.

The patient was fairly comfortable within twelve hours after the beginning of this treatment, and was entirely free from pain within thirty-six hours from this time. His temperature and pulse were nearly normal within three days after this time. Had the patient been permitted to take food there is no doubt but that the vomiting would have persisted, and that the peristaltic motion of the small intestines would have carried the septic material over the entire surface of the general peritoneum, and that the case would have ended fatally unless the patient's life had been saved by an operation during the height of the attack of general peritonitis, which, with the condition of the patient when he entered the hospital, could scarcely have been expected.

Case X. illustrates the importance of this treatment even more strongly. When I first examined

this patient he was in a farmhouse; there was no trained nurse available, neither were there trained assistants at hand. The patient's temperature was 104° F., his pulse was 140; his abdomen was enormously distended; his features pinched and he was delirious. My experience with similar cases had taught me that whenever I operated upon patients approximately in his condition the patient invariably died.

Some years ago, before I had learned to appreciate the treatment which I now describe, I frequently operated upon patients in just this condition, as a last resort, thinking that this gave them the only possible chance of recovery. Since then I have learned that this case belonged to a class which practically never recovered after an operation, if it is done while the condition is that in which I found this patient, and of which a very large majority recover if the treatment is followed which I have described. In this case the operation demonstrated the fact that the child had indeed suffered from a diffuse peritonitis due to a perforation of the appendix, and still, with this treatment, within two days the patient was practically out of danger and went on to a complete recovery from this acute attack, the only pathological conditions remaining being the presence of an enterolith in an adherent, perforated appendix, together with diffuse peritoneal adhesions—conditions which

could be relieved with perfect safety by an operation performed in the interval.

Of course, in both of these cases I have mentioned for the purpose of illustration, a recurrence would be almost certain to take place if the appendix were not removed in the interval, but the conditions under which the operation can be performed in the interval are so safe that an operation at that time cannot be compared to an operation which takes place under the conditions in which the patients were when I first saw them.

It is for this class of patients that I would advise the treatment by exclusive rectal alimentation most strongly, because if they are operated upon during the attack the result will, ordinarily, lack much of being perfect. In the first place, drainage will be indispensable. This makes the occurrence of a ventral hernia very likely. Consequently, the patient will be compelled either to suffer the annoyance of wearing a truss or he will have to undergo an operation for the relief of this ventral hernia. This operation, in itself, is fully as difficult and dangerous as the operation for the removal of the appendix in the interval. The patient, therefore, has gained nothing from the primary operation.

Moreover, it is occasionally impossible to remove the appendix during the height of the primary attack, and that portion of the operation will fre-

quently have to be added to the operation for the relief of a ventral hernia.

The use of drainage is often followed by the presence of strong peritoneal adhesions, which will be much slower to absorb and disappear than the adhesions which occur if the method is followed which I have described. In fact, it frequently happens that instead of a somewhat adherent, crippled appendix such as we would be likely to find in a case which has been treated in the manner I have described, we will find a patient with a ventral hernia, with the same kind of an appendix still present, together with a large number of troublesome adhesions. Moreover, the patient has been exposed to the dangers of an exceedingly severe operation at a time when he was least able to withstand it.

I have had an opportunity to observe a very large number of these patients under this form of treatment, and have operated upon many of them at various intervals after the acute attack through which they were treated in this manner, and have been able to demonstrate that the patient can recover, and practically always does recover, if this method of treatment is employed. Of course, one occasionally encounters a patient suffering from appendicitis who is in a dying condition, and then neither this nor any other method is of any value.

I could easily produce statistics which would

prove that this form of treatment will reduce the mortality enormously, but in the treatment of a disease in which there is such a variety in the severity of attacks it is impossible to place much value upon statistics. I can, however, say that taking appendicitis patients as they come in my own practice, the mortality in these cases has decreased enormously since I have employed this method, and this has also been the experience of my colleagues who have tried the same plan of treatment.

There is one source of danger which I must mention, however, and which has resulted in the loss of one life in my practice, namely this: a young man, 27 years of age, strong and healthy in every other way, suffered from an acute attack of appendicitis. He was unwilling to submit to an operation, although he was seen by my assistant a few hours after the beginning of the attack, and by myself within twelve hours of that time. The attack began with great violence, and I urged the advisability of an operation. This being refused, I treated him by exclusive rectal alimentation, and in three weeks he was able to follow his occupation, which was that of a clerk in a railroad office. Six months later he had a second violent attack, and again refused the operation which was urged, and he again recovered under the same treatment. After another six months, during my absence from

the city, he had a third attack, and was treated by a colleague, who placed him on liquid diet for four days, at the end of which time he was in a precarious condition, whereupon a surgeon was called who operated as a last resort while the patient was in a condition similar to that which I have described in the two cases mentioned above. The patient died within two days after the operation.

Had this patient been operated at the beginning of his first or second attack, his chances of recovery would have been much better than they were on the fifth day of his third attack after having been fed by mouth for four days.

Since that time I have invariably insisted upon an operation in the interval after the patient has recovered temporarily from the acute attack. It is, however, wise to wait until the infectious material has been practically all absorbed. There is great danger in operating too soon after the patient has recovered from the acute attack, because the infectious material may still be present, necessitating drainage. Moreover, a general peritonitis may be kindled up by an operation performed too soon after the recovery from an acute attack.

I believe there is great wisdom in the statement by Richardson, that "there is a time too late for an early operation, and too early for a late operation."

If this method of treatment is employed it is

practically always possible to wait until the proper time has come for a late operation, although I have myself operated in a number of instances in cases which should have been postponed for several weeks longer, and my patients have suffered as a result of this blunder. This blunder is so much more likely to occur because the local conditions frequently improve very rapidly, even in cases in which there are very extensive and very serious pathological lesions. This fact can easily be comprehended when one remembers that the conditions for the relief of these pathological lesions are exceedingly favorable.

The vascular supply of the omentum is enormous and is increased to many times its normal amount if necessary. The omentum winds itself around the infected appendix and at once proceeds to repair the damage which has been done. Of course, if the patient has been fed these conditions have constantly been disturbed and the omentum cannot apply itself entirely to its duties towards the diseased appendix. Moreover, the infection in other portions of the peritoneum necessarily demands a portion of the omentum's attention, so that unless strong adhesions have already formed between the omentum and the appendix, the former may not remain applied to the latter sufficiently long to accomplish these protecting adhesions.

I believe that this accounts for the fact that in some cases the omentum is not gathered around the diseased appendix, as it is ordinarily, and cannot, consequently, afford the same protection.

Whatever one's views may be concerning the indication for operation, there is one class of cases in which I am absolutely positive, from my experience as well as from my personal observation of the work of other surgeons and the study of the literature on the subject, that the treatment I have just described should be invariably substituted for the operative treatment.

I refer to the class of cases which Mynter has described so clearly in his splendid book under group 3. I cannot do better than quote his paragraph from page 172:

"The third group is represented by twenty cases, Nos. 31 to 50 inclusive, all of which had gangrene with perforation and beginning or diffuse peritonitis. Five of these recovered while fifteen died, one of gangrene of the cecum and one of pyelophlebitis suppurativa after the peritonitis had disappeared, and thirteen of diffuse peritonitis. Two were operated on within twenty-four hours, three on the second day, three on the third day, five on the fourth day, two on the fifth day, four on the sixth day and one on the seventh day. The five who recovered were operated on in two cases on the first day, in two cases on the second day, and

in one case on the third day. Of the fifteen patients who died, one was operated during the second day, two on the third day, five on the fourth day, two on the fifth day, four on the sixth day, and one on the seventh day. Comments seem unnecessary. All died if operated on later than the third day."

In the entire literature on appendicitis there is not another sentence which says so much as the last sentence quoted. It expresses my own experience before I made use of the treatment by exclusive rectal alimentation so absolutely that I feel personally thankful to the author for his blunt, clear and positive statement. It covers the class which Richardson has described as "too late for an early operation and too early for a late operation." Every surgeon with an extensive experience can recall many of these cases, and without the treatment which I have just described one must naturally come to the conclusion that the fault lies in making the diagnosis too late or in deciding to operate too late, which in itself is undoubtedly very true, for had these twenty patients all been operated within the first twenty-four hours by a competent surgeon, I have no doubt but that all would have recovered. Unfortunately, this cannot be at the present time or, at least, it is not the case.

In looking over my own histories I find that I

was called to see my appendicitis patients during the first twenty-four hours in less than ten per cent. of the cases, and I believe that this is the experience of all surgeons, consequently, there must always be a comparatively large number of patients in whom an operation promises very little, i. e., exactly the class of patients which Mynter has described in his third group. In looking over these histories carefully I find that these cases correspond to cases which I lost almost invariably before I employed the treatment by exclusive rectal alimentation, and which now almost invariably recover.

The patient with a temperature of 103° F., pulse of 140, considerable meteorism, costal respiration, intense tenderness over the whole abdomen, with rigidity of the muscles and symptoms of collapse, will die almost invariably without even recovering from the shock of the operation if the latter is performed. Place this patient upon exclusive rectal alimentation, after emptying the stomach of its load of septic, decomposing material by gastric lavage, and the patient's pain will disappear within twelve hours; the temperature will fall from one to three degrees in twenty-four hours; the pulse will be below one hundred beats per minute; the symptoms of collapse and the anxious facial expression will leave, and the tenderness and meteorism will have decreased; the

rigidity of the muscles may persist for two or three days, but will decrease constantly, though slowly. In the meantime a circumscribed abscess may form which will require opening, or which may evacuate into the cecum, or there may be absorption of all the products of inflammation, and when the abdomen is opened a month later nothing may be left except diffuse adhesions. If the abdomen is opened a year later even these adhesions may have disappeared to a great extent.

I have had many opportunities to demonstrate this, especially in cases in which I performed a secondary operation, for the relief of ventral hernia, a year or more after performing a primary operation in cases in which it was impossible safely to remove the appendix in the primary operation, in which there was a diffuse peritonitis at the time of the operation and in which drainage had to be maintained for a considerable time.

I will describe but one of these cases—a young, unmarried woman, 22 years of age, who had suffered from acute perforative appendicitis for ten days before I was consulted. At this time she had an abscess extending through the entire right half of her abdomen from the umbilicus to the cul-de-sac of Douglas. Her abdomen was enormously distended, but there existed this abscess which was circumscribed notwithstanding its great size. I made an incision three inches in

length over its most prominent point, which corresponded with McBurney's point, and evacuated about two quarts of exceedingly fetid pus containing two fecal concretions. The patient's condition was so bad that I found it unwise to prolong the operation beyond a simple incision and the application of glass tubes and gauze drainage. The drainage was continued for three weeks when the wound was permitted to heal. Undoubtedly there must have been very diffuse adhesions in this case.

Fifteen months later I operated upon the same patient for the relief of a ventral hernia and to my surprise found nothing left of these adhesions except an adhesion between the omentum, the remnant of the appendix, which had been almost totally destroyed by the gangrenous inflammation, and the hernial sac.

I have found very similar conditions many times, which have led me to think very well of the reparative processes which go on in the abdominal cavity.

I could cite a very large number of cases belonging to this group, in which the treatment by means of exclusive rectal alimentation resulted in a favorable recovery, when from all of my past experience and observation the case looked absolutely hopeless if an operation should be performed during the attack.

I must once more refer to the fact that in carrying out this form of treatment it is important not to administer cathartics except in cases in which one is called early enough to be able to have the cathartic pass the ileocecal valve before there is any danger of perforation of the appendix, because the cathartic will cause precisely the same disturbance as the food taken by mouth. It will start peristaltic motion, disturb the rest of the inflamed appendix and it may in this way not only be the means of distributing septic material, which had been localized in the region of the appendix, to different parts of the peritoneal surface, giving rise to diffuse peritonitis, but it frequently causes a rupture of an appendix which had previously been protected by the omentum, and it always gives rise to severe pain.

A number of years ago a saying was popular in some of the European clinics to the effect that many physicians saved the lives of their appendicitis patients by the administration of opium, and after they had accomplished this they killed them by the administration of cathartics. In other words, the opium treatment which Volz introduced in 1843 accomplished very much the same result as the treatment I have described, but in a manner less safe and very much slower, and less agreeable to the patient. In the first place it secured rest for the inflamed appendix and

gave the omentum an opportunity to apply itself around the latter. In the second place it spoiled the patient's appetite so thoroughly that he could not eat anything even if it were offered to him.

The theory of the treatment was wrong in so far as its aim was to prevent evacuations of the bowels. And still, this treatment was so much better than any other of its kind that a noted English author, who had visited the clinics of Germany before and after the introduction of this treatment, stated that before the beginning of this treatment he could count the cases of peritonitis which he had seen get well in Germany upon the fingers of his hands, while after the introduction of the opium treatment he could count those which he had seen die upon the fingers of his hands, that the mortality was enormously reduced, that in fact there was a complete revolution in the treatment and a complete change in the mortality from peritonitis which, we now know, is in a great majority of cases due to appendicitis.

Hawkins believes in the harmfulness of cathartics in the treatment of appendicitis. He advises that no purgatives be given until the patient is able to leave his bed.

I find that many authors advise rectal feeding under certain conditions, but I am certain that the exclusive rectal alimentation is of greater

importance in the treatment of appendicitis than any other single method, but I am equally certain that it must be carried out thoroughly, because even a small amount of food or the administration of a cathartic may suffice to bring about a fatal issue.

I am also certain that many patients are enormously benefited by the use of gastric lavage for the purpose of removing a quantity of decomposing material, the absorption of which would certainly do a great amount of harm. I am also certain that gastric lavage does permanent good only if no further food is placed into the stomach, which would result in further decomposition.

The treatment of appendicitis by exclusive rectal alimentation would then be indicated in all patients in whom, for any reason, the removal of the diseased appendix cannot be safely accomplished by means of a surgical operation.

I am certain that if this plan is adopted in all such cases the mortality from appendicitis will be enormously reduced. It is for this reason that I have spoken of this method of treatment so fully.

There are many other points which recommend this form of treatment:

1. It can be employed by any practitioner under all possible circumstances. If no concentrated food can be secured, normal salt solution may be substituted for several days. A patient will not

suffer greatly for want of food if a proper amount of fluid is supplied to him. If none of the concentrated foods can be procured, equal parts of warm milk and normal salt solution may be employed.

2. In case there is any doubt concerning the diagnosis, the patient can be observed safely under this method. In fact, the conditions most commonly mistaken for appendicitis, of which we have spoken before, would all be benefited by this form of treatment, hence, it would not only be safe but also distinctly beneficial.

3. If no competent surgeon is available the patient's chances for recovery are not reduced by the necessary delay if this method is employed.

CHAPTER VIII.

THE SURGICAL TREATMENT OF APPENDICITIS.

It has seemed to me most fortunate that this form of treatment should have been first advocated by a great physician, and pathologist, like Fitz, rather than by a surgeon, because this gave at once the strength coming from the fact that there could be no natural prejudice in favor of surgical treatment.

There is no doubt but that a diseased appendix is not a desirable organ to possess, and that a person is much more fortunate if he is entirely without an appendix than with this organ in a diseased condition. If the pathological condition is chronic, as has been shown before, the patient's digestion is likely to be constantly impaired and he is threatened with chronic invalidism. If there are more or less severe recurrent attacks, the patient's business or profession will suffer severely by his inability to perform his duties with regularity; if he is a wage-earner his employers will dismiss him after a few attacks and replace him by a man who can be depended upon.

Moreover, all of these sub-acute and chronic conditions may at any moment be kindled up into

acute conditions, and then the patient's life will actually be in danger. Consequently, I believe that if a diseased appendix can be safely removed this should be done.

In acute appendicitis there is, with one exception which will be discussed later, always a time during which all of the infectious material is still within the walls of the appendix and can, consequently, be removed without coming in contact with any other portion of the peritoneal cavity. This is practically always the case within the first twenty-four hours, almost always within the first thirty-six hours, and usually even within the first forty-eight hours after the beginning of an attack. If a competent surgeon is available and the other conditions, which are necessary to secure success, are at hand then, I believe, it is always wise to remove a diseased appendix during an acute attack, so long as one can be fairly certain that the infectious material is still within the walls of the appendix, for the following reasons:

1. Under these conditions the patient will almost always recover.

2. The appendix can be removed with comparative ease.

3. There is no occasion for draining the abdominal cavity, consequently, no likelihood of the occurrence of a ventral hernia following the operation.

4. For the same reason there cannot be extensive adhesions which might impair the future health of the patient.

5. There can be no recurrence.

6. The patient will be ill only a short time and can follow his profession or trade within a short time.

7. His happiness is not disturbed by the constant anxiety due to the knowledge of the presence of a diseased appendix.

8. It prevents chronic invalidism.

It is true one cannot always be certain that the infectious material is still confined within the walls of the appendix, but with increased clinical experience one can be constantly more certain. In case, however, one should be mistaken in this particular point, one can still treat the patient safely by making use of drainage, of course endangering the patient to the risk of increasing the peritoneal infection, as well as to the likelihood of the subsequent formation of a ventral hernia and adhesions.

So far I believe most surgeons are agreed, but from this point on many differ; personally, I favor the treatment of cases which have advanced further by the use of the exclusive rectal alimentation, until all of the acute symptoms have disappeared for at least two weeks, and to remove the appendix at that time, because then, again, all of

the advantages which I have mentioned in connection with the operation during the very beginning of an acute attack, obtain in every particular.

If, in the meantime, a circumscribed abscess has formed, I believe it is wise to evacuate this and to drain the abscess cavity, and if the surgeon has a sufficient amount of skill to remove the appendix at the same time, without endangering the life of the patient, I believe that this is indicated, but if there is any doubt in regard to this part of the operation I believe it is always best simply to drain the abscess, and to remove the appendix at a future operation because this usually becomes necessary for the closure of a ventral hernia which is likely to follow drainage.

As the surgeon's experience and skill increase with practice, he will be able to remove proportionately more and more of these appendices with safety, but I believe that in any given case the removal of the appendix after the abscess has been opened should depend upon the fact that, in the judgment of the surgeon, to perform this operation is a safe procedure with the amount of skill he may possess.

To all cases of chronic appendicitis we can again apply the same rules that we made use of in the treatment of acute appendicitis, in cases in which the infectious material was still confined to

the appendix, and the same conclusions, I believe, will be tenable.

Many patients are semi-invalids for many years, become old prematurely, and finally die from some other disease on account of lack of resistance, simply because their digestion has constantly been impaired as a result of a chronic appendicitis; or their invalidism may depend upon the constant presence in their system of septic material carried about in a diseased appendix.

I have seen many a man suffering from poverty because his recurrent appendicitis prevented him from obtaining permanent, profitable employment, when a few weeks of confinement in a hospital and a safe operation might have removed all of these sources of suffering.

It is true that recurrences can usually be prevented by careful attention to diet, by securing daily free evacuation of the bowels, by avoiding over-work and above all things by abstaining from eating too freely, especially of indigestible food when tired. Notwithstanding these facts most patients will never be entirely well after recovering from an attack of appendicitis, and if this is the case I believe that the best treatment consists in the removal of the diseased appendix.

Operation for the Removal of the Appendix.

PREPARATION FOR OPERATION.

In acute appendicitis, if the patient is seen during the first thirty-six hours, when the septic material is still confined to the appendix and the peritoneal cavity is still quite free from infectious material, there should be very little time wasted in preparation of the patient, because in this condition time is valuable. If a well-equipped hospital can be reached without disturbing the patient too much it is well to move the latter carefully because the operation can, of course, be performed more readily there than elsewhere. If this is not convenient, however, it will do to operate in any house. The patient may be placed on any table which has been covered with a sterilized sheet. The abdomen is carefully washed with soap and warm water, care being taken not to do mischief by too vigorous manipulations for fear of causing a rupture of the infected appendix, and a consequent infection of the peritoneal cavity. The surface is then shaved and again washed with warm water; then with strong alcohol, and then with a 1 to 1000 solution of corrosive sublimate in water. It has been demonstrated beyond a doubt, however, that if the surface is simply washed with soap and warm water and then with pure, warm, sterilized water, there will be no in-

fection from the skin. If, however, alcohol and corrosive sublimate are available there is no harm in their use, and as there is a strong superstition in their favor it is quite as well to use these antiseptics.

The patient is now covered with dry sterilized towels with the exception of the lower right one-fourth of the area of the abdomen.

INCISION.

There are many incisions which have been practiced by various surgeons, but the one advised by McBurney, according to which the muscles of the abdominal wall are simply separated without being severed, is, in my opinion, to be preferred in all cases in which it is likely that the appendix can be found and removed without much difficulty. The author describes this incision as follows: "Beginning at a point one inch above the line drawn from the anterior iliac spinous process to the umbilicus, passing obliquely downward, an incision is made which crosses that line at a point one and a half inches internal to the spinous process and corresponding as accurately as possible in direction to the fibers of the external oblique muscle and aponeurosis." Its location and direction is clearly shown in Fig. I. Its length depends upon the thickness of the abdominal wall; in case this is thin a two-inch incision is quite sufficient. In

a very obese patient it is often wise to make a long incision through the skin and fat down to

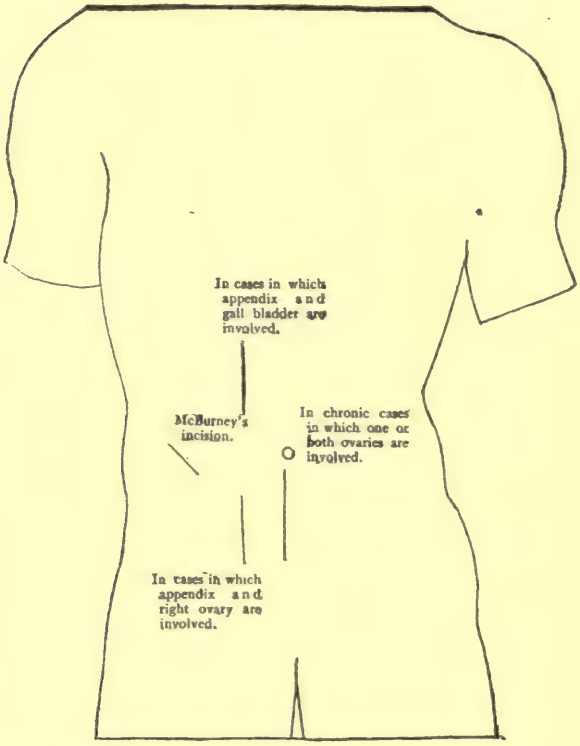


FIG. I. The various incisions used in appendectomy.

the external oblique muscle and fascia, in order to gain space, and to make the incision through

the latter only the usual length of two to three inches. Another general rule is applicable here; the length of the incision should vary, inversely, with the experience, skill and dexterity of the operator.

In the beginning of one's practice an operation

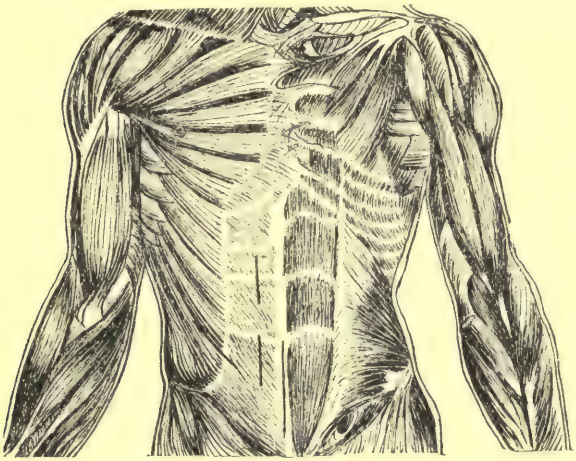


FIG. II. The muscles of the abdomen in relation to the incision.

can be done with much greater safety through a large than through a small abdominal incision, while this is not true as one's experience, skill and dexterity increase.

The incision is then carried down to the internal oblique abdominal muscle, simply splitting the fibers of the external oblique muscle and fas-

cia without cutting any of the fibers. The edges of the latter muscle are now held apart with retractors, and this exposes the internal oblique

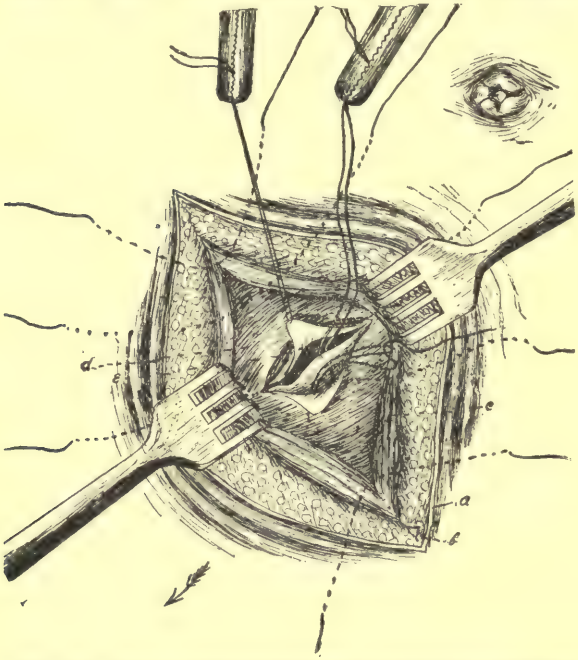


FIG. IIIA. Showing the layers of tissue and McBurney's incision; *a*. Skin; *b*. Subcutaneous fat; *c*. Fascia of ext. oblique muscle; *d*. Internal oblique muscle; *e*. Peritoneum and transversalis fascia; *f*. Silk suture applied as suggested by Robert Morris.

muscle in the depth of the wound, with its fibers extending at right angles to the incision. These are now separated, care being taken not to cut any

of the fibers, but simply to separate them. In most patients this exposes the transversalis fascia,

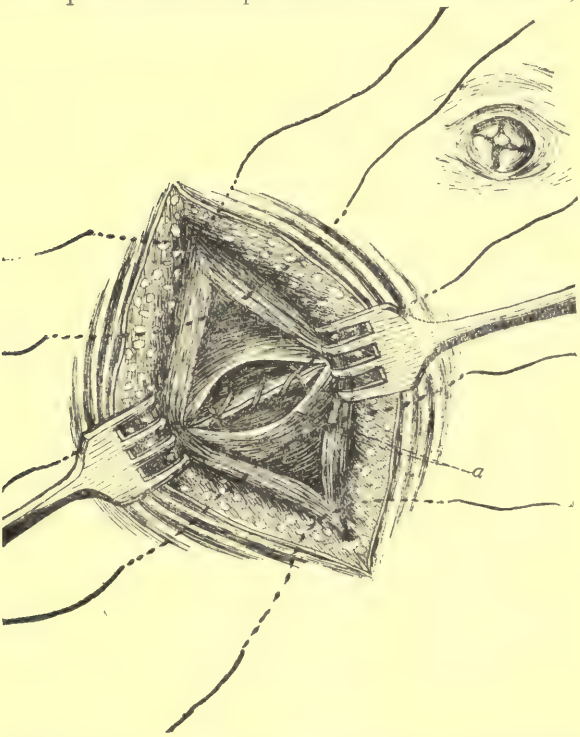


FIG. IIIB.—Showing all the layers of tissue in McBurney's incision, with silkworm gut suture in place but not tied, and the layer of peritoneum and transversalis fascia already sutured.

but in some very muscular patients fibers of the transversalis muscle may be seen at the bottom

of the wound extending almost directly from right to left. In the latter case it is well to make an incision down through this muscle and fascia, and the underlying peritoneum, in a transverse direction, again splitting but not cutting the muscle fibers. In the other case it is just as well to pick up the transversalis fascia and the peritoneum together, and to cut them in the direction of the fibers of the internal oblique muscle. All of these layers and incisions are shown in Fig. III.

If the wound thus made does not seem quite sufficient McBurney suggests stretching it with two fingers or with a pair of blunt retractors.

Wier has made a valuable suggestion which consists in making a slight incision across the fascia, covering the outer edge of the rectus abdominis muscle, and then enlarging the wound by stretching. The wound can thus be increased to more than double its original size without in any way impairing or disturbing any of the structures which must be utilized later for the purpose of closing the abdominal wound in a manner that will prevent the formation of a ventral hernia.

Robert Morris has made a suggestion which, although it seems scarcely of enough importance to be worth trying, is really of very great practical assistance. Instead of simply making the incision through the transversalis fascia and peritoneum, he passes a silk stitch through the middle of each

edge of the wound made in these tissues, attaches a pair of forceps to this stitch and later uses these stitches to bring this layer into view when the wound is closed (Fig. III). This little expedient really aids greatly in closing an abdominal wound if the incision is short.

The abdomen being opened at this point the inflamed appendix usually appears in the wound. If this does not occur it should be sought in a systematic way, because this will very greatly reduce the amount of manipulation which is required, and there can be no doubt but that the mortality after operations for the relief of acute appendicitis depends very largely upon the amount of manipulation, and many deaths are unquestionably due to unnecessary manipulation when searching for the appendix in a haphazard manner.

In order to find the appendix one should always first locate the cecum, which can be done very easily, as the latter extends along the right abdominal wall and is distinctly marked by a band of longitudinal muscle fibers extending along its surface and dividing the intestine into two equal parts (Fig. IV). Following this longitudinal band downward the appendix is encountered, or it may be surrounded by omentum or intestines, which are adherent to it, and these will then be encountered. As soon as the appendix has been located it is well to lift up the abdominal walls by

means of blunt retractors and carefully pack the remaining portion of the abdominal cavity away from the area which may be infected, using aseptic gauze pads moistened in warm normal salt so-

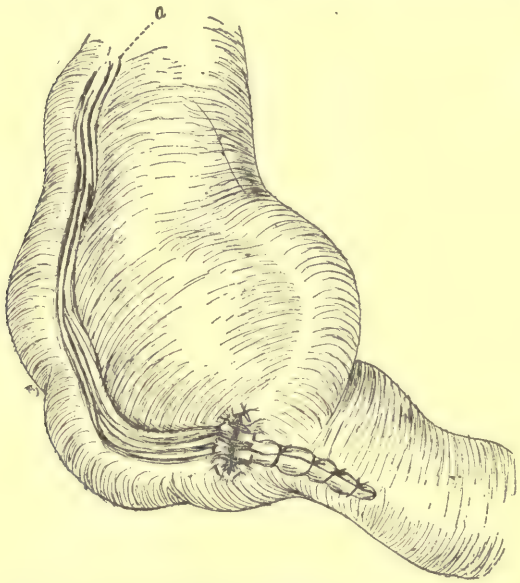


FIG. IV. Showing longitudinal band on cecum and appearance of cecum after peritoneum has been sutured.

lution. If the appendix is neither adherent nor perforated, so one can be certain that all of the septic material is still in the appendix, it is not necessary to pack away the remaining portion of the peritoneal cavity. The appendix, together

with the lower end of the cecum, is simply lifted out of the peritoneal cavity, surrounded by warm,

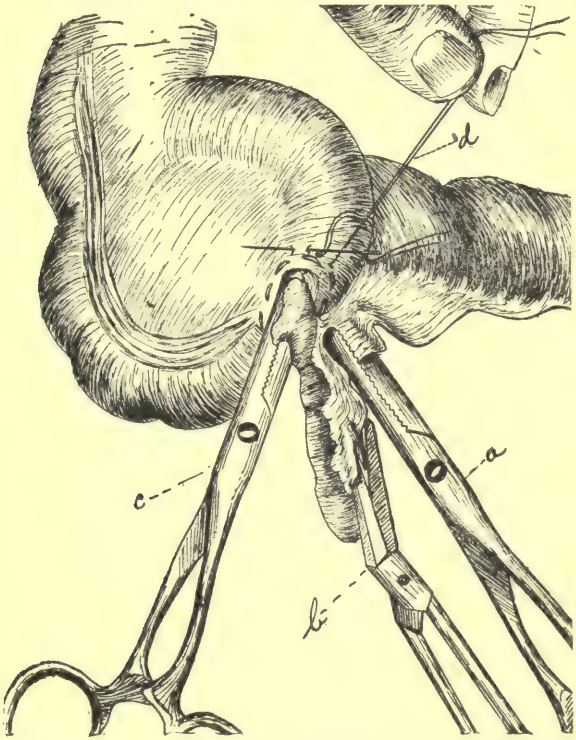


FIG. V. Showing method of clamping appendix and mesentery and placing purse-string suture.

moist, gauze pads, and the appendix is removed according to the method illustrated in Fig. V.

The mesentery of the appendix is grasped in a pair of long-jawed forceps (Fig. Va), the points of which extend to the cecum; then the attachment to the appendix is severed (Fig. Vb). Then a strong pair of forceps is applied to the cecal end of the appendix and firmly clamped in order to thoroughly crush the tissues, and act after the fashion of an angiotribe (Fig. Vc). The mesentery of the appendix is then ligated; and a circular stitch is applied one-eighth of an inch from the base of the appendix (Fig. Vd), as suggested by Dawbarn. Another hemostatic forceps is now applied to the appendix a quarter of an inch beyond the first one in order to prevent the contents of the appendix from infecting any of the tissues. The appendix is then cut away with a sharp scalpel directly beyond the first forceps. After carefully sponging the surface of these forceps to prevent any particles which may have escaped from the lumen of the appendix from causing an infection, the forceps are loosened from the stump of the appendix, and this is inverted into the cecum while the circular stitch is being tied (Fig. VI). A few supplementary Lembert stitches are applied over the depression formed by tying the circular suture, and this portion of the operation is completed (Fig. IV). The cecum is now dropped into the abdominal cavity and the abdominal wound is closed.

The peritoneum and transversalis fascia are now drawn up, as shown in Fig. IIIa, and united by continuous catgut sutures. The parts of the wound

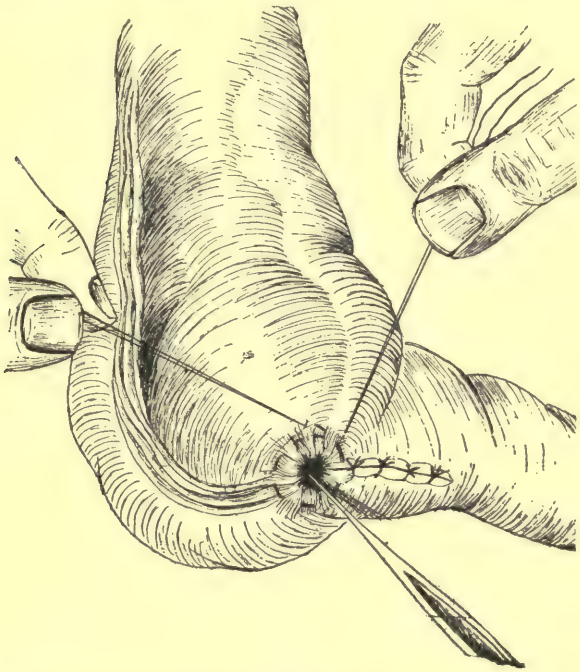


FIG. VI. Showing manner of burying stump of appendix.

through the internal oblique muscle will then lie in apposition, and all that will be required to secure a strong permanent union is accomplished

by applying a few interrupted catgut sutures, as shown in Fig. VII. In order to overcome the slight depression left at this point, it is well to suture the delicate fascia covering the outer surface of the internal oblique muscle separately. The ex-

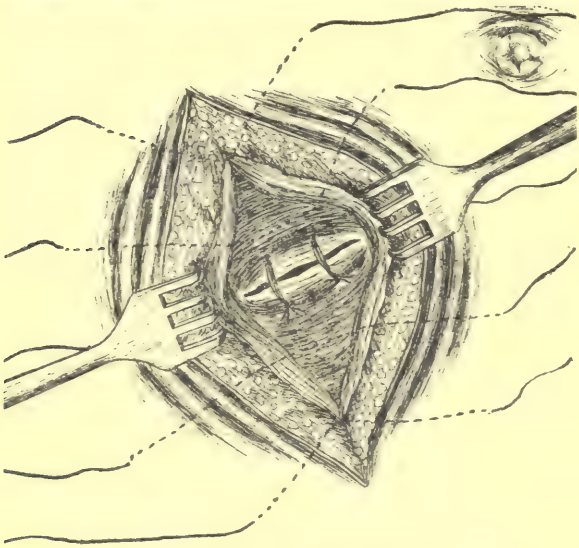


FIG. VII. Showing interrupted sutures uniting internal oblique muscle.

ternal oblique muscle and fascia are then sutured in the manner shown in Fig. VIII. Then the skin is closed with horse-hair sutures, either interrupted or continuous. It does not matter what suture material is used, catgut, kangaroo tendon or

silk being preferable, however, for buried sutures.

In chronic appendicitis, complicated with gall stones, or in cases in which the presence of gall

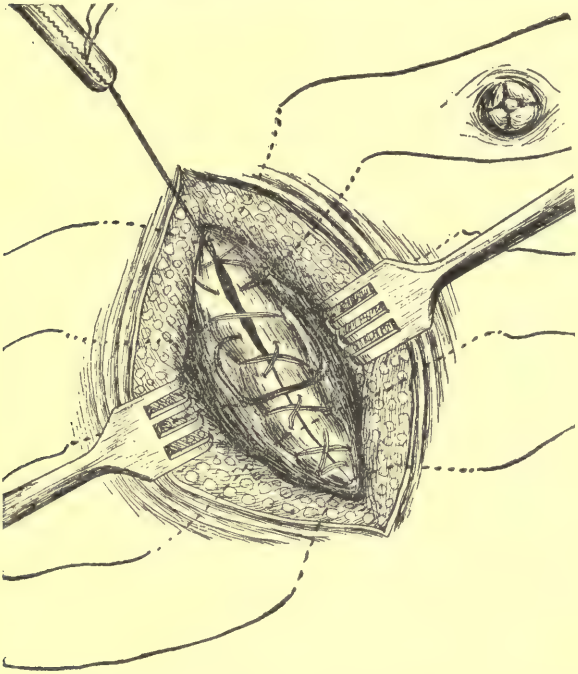


Fig. VIII. Showing manner of suturing fascia of external oblique muscle.

stones is suspected, it is preferable to make the incision through the right rectus abdominis muscle about three-quarters of an inch from its

outer border at a point opposite the umbilicus (Fig. 1). Usually an incision two and a half inches in length will suffice. If gallstones are found, the incision can readily be extended upward, and if the appendix is found extensively adherent the incision can be extended downward. In all other respects, except the closure of the wound, the operation will be identical with the one already described.

CLOSURE OF WOUND.

The wound is closed by inserting a row of silkworm gut stitches, one inch apart, beginning a quarter of an inch from the margin of the wound. The needle is passed through the skin and superficial fascia, then the deep fascia—composed at this point of the aponeurosis of the external oblique muscle and the outer half of the aponeurosis of the internal oblique muscle—is drawn forward so that the needle catches three-quarters of an inch of this structure; then an equal amount of the rectus abdominis muscle is caught in the stitch; then the needle is passed across the wound without touching the peritoneum and carried outward through the successive layers in the inverse order taken upon the opposite side. These stitches are left untied until the following buried catgut stitches have been applied. A continuous catgut suture is now applied to the edges of the layer

composed of the peritoneum and transversalis fascia, which at this point is united with the inner layer of the aponeurosis of the internal oblique abdominal muscle. It is well to pass these stitches over the silkworm gut sutures in order to prevent the formation of dead spaces when the latter are tied. After this a few interrupted catgut sutures are applied to bring the parts of the rectus muscle in accurate coaptation.

Then the strong fascia, composed of the aponeurosis of the external oblique and the outer layer of the internal oblique is united by a continuous catgut suture; and over all of this the deep silkworm gut sutures are tied and a row of continuous horse-hair sutures is applied for the purpose of securing an accurate coaptation of the skin. It is important to remember that none of these stitches should be tied tightly for fear of weakening the abdominal wall on account of pressure necrosis, which is very likely to occur.

In case an infection of the right fallopian tube or ovary is suspected, it is best to make the incision through the right rectus abdominis muscle at a point half way between the pubis and the umbilicus (Figs. I and II). From this incision the ovary and tube can be examined, and if necessary removed; and, in fact, the uterus and the left tube can be treated from this incision. If, however, it is desirable to examine both ovaries and tubes,

as well as the uterus, it is best to make the median incision (Figs. I and II), because from this the

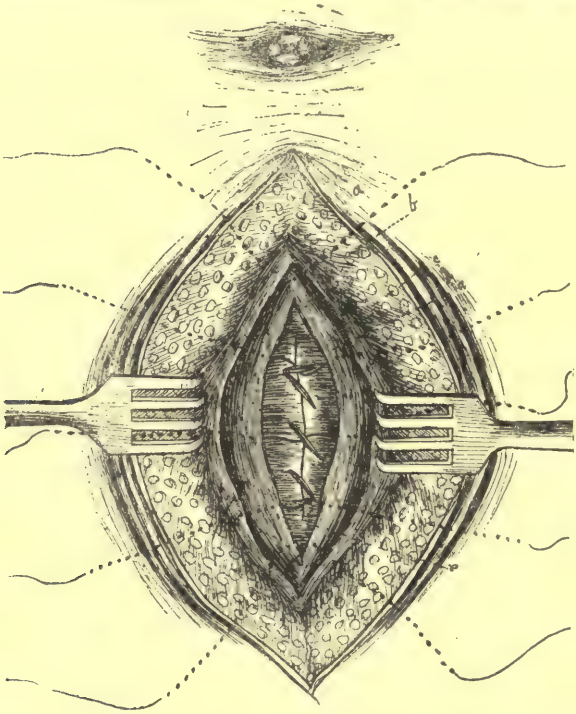


FIG. IX. Showing manner of inserting deep silkworm gut sutures in closing abdominal incision.
a. Skin. *b.* Subcutaneous fascia; *c.* Strong fascia; *d.* Rectus abdominis muscle; *e.* Transversalis fascia and peritoneum.

appendix can usually be removed in chronic appendicitis without difficulty. The abdominal

wound in this incision, as well as in the previous one, is closed in the manner already described in connection with the incision through the upper portion of the rectus abdominis muscle. In all of these incisions the wound can be closed satisfactorily by the use of only one row of silkworm gut sutures applied as shown in Fig. IX, with the exception that they pass through the layer composed of the peritoneum and transversalis fascia also, great care being taken to prevent this from folding in between the other layers by grasping only a very narrow portion of this layer. If a surgeon is in the habit of drawing his stitches very tightly, I am inclined to believe that this method of closure is more satisfactory than the method described before; but if the catgut employed is reliable and the wound is clean a ventral hernia practically never occurs if the abdominal wound is closed by the use of deep silkworm gut sutures, and the various layers are sutured separately with catgut, as described before. Figs. IX, X and XI illustrate the method of closing the abdominal wound in the median line, but the same method applies if the incision is through the rectus abdominis muscle.

The wound is dressed with sterilized gauze and cotton; a narrow piece of soft gauze is placed over the wound and the abdominal walls are supported by the application of broad bands of rubber ad-

hesive plaster. We have found that the scar is much more delicate if the strips of adhesive plas-

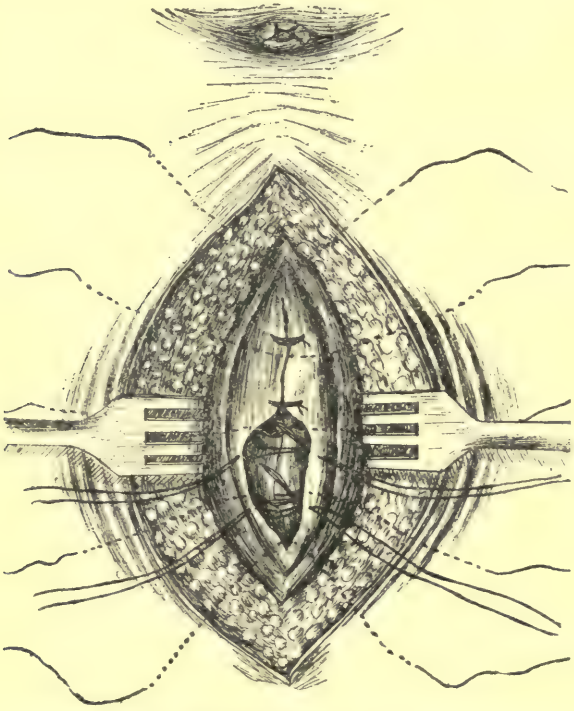


FIG. X. Showing deep silkworm gut stitches, peritoneal catgut stitches, uniting rectus abdominis muscle in place.

ter used are at least two inches in width than if they are narrower, undoubtedly because the ten-

sion upon the healing tissue is thus very greatly decreased.

In case the appendix and the surrounding struc-

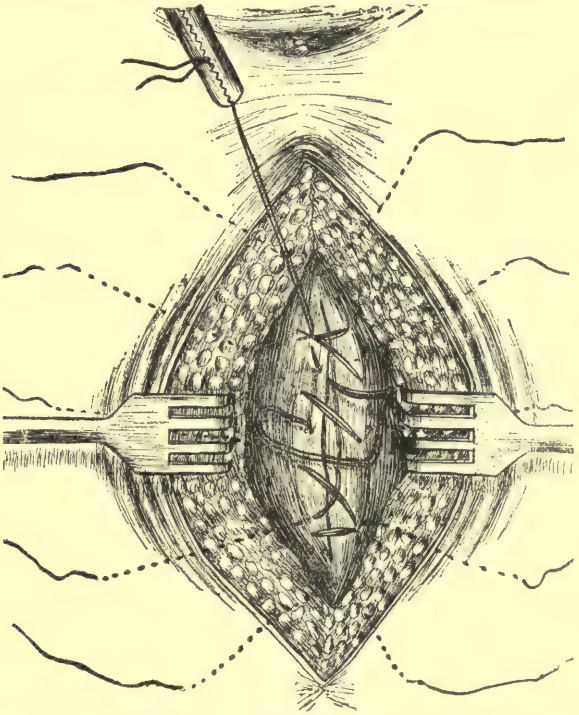


FIG. XI. Showing continuous catgut sutures uniting strong fascia—aponeurosis of external and internal oblique.

tures—the omentum, the cecum, the ileum, the parietal peritoneum, and, possibly, the right ovary

and tube, uterus and bladder—are extensively adherent, especially if there still exists a certain amount of suppuration, the operation must be planned in a different manner, although the same general principles must be employed. It is still necessary to limit the amount of manipulation to the smallest possible extent; to perform the operation with as little disturbance to the surrounding structures as possible, and it is also necessary to prevent the existing pus from invading the non-infected tissues. In order to accomplish all of these objects it is usually best to secure from the first an abdominal wound sufficiently large to permit quite free manipulations. This can be secured through the McBurney incision (Figs. I and II) by cutting the fascia covering the outer edge of the rectus abdominis muscle transversely, and permitting the inner portion of the wound in the internal oblique muscle to separate, a method advised by Dr. Robert Wier.

If one anticipates difficulties of this character, however, I believe the incision through the right rectus abdominis muscle is to be preferred, because this can be lengthened to any desirable extent without necessitating pulling and tearing upon the tissues. An incision two and a half inches long is usually sufficient to begin with; through this one can determine the conditions present. The location and size of the appendix

can be determined as well as the extent of the adhesions and the degree of inflammation which still exist.

If the cecum and appendix can be brought out of the abdominal wound without fear of rupturing an abscess, the operation can be completed after the manner already described. If, however, there is any doubt, or if it seems likely that an abscess will be opened during the removal of the appendix, it is best to enlarge the incision sufficiently to bring the entire intra-abdominal field of operation under control. Then a piece of moist, sterilized gauze is placed over the cecum and appendix so that these parts are not likely to be disturbed, while the other portions of the abdominal cavity are banked off by means of large, moist, sterilized gauze tampons, the abdominal walls being at the same time lifted up with blunt retractors. This can be accomplished without crushing or roughening the delicate serous surface covering the intestines. It is important that this be borne in mind because an injury to these surfaces is likely to favor infection to a great extent.

If the appendix cannot be located at once it is best to follow the longitudinal band on the surface of the ascending colon downward over the cecum; when the point is reached at which the ileum passes into the cecum the surgeon can be confident that the appendix is not far away. It

may extend upward behind the cecum, or it may be curled up on the lower end of the cecum (Fig. XII), or it may extend inward and may be adherent between a number of loops of small intestines; or it may extend downward and be adher-

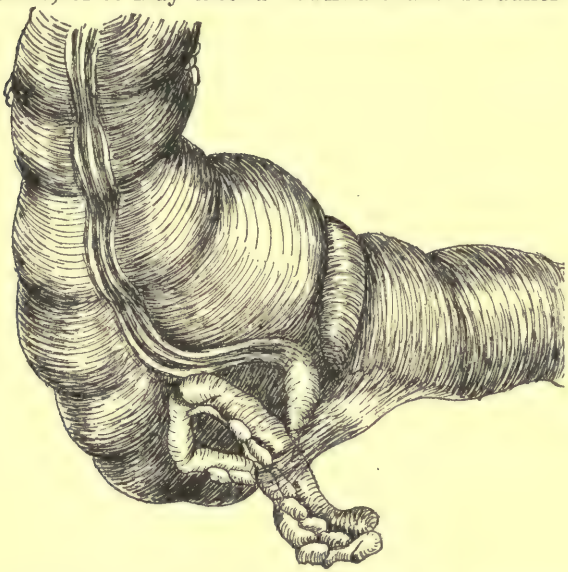


FIG. XII. Showing the appendix curled up on the lower end of cecum and held in place by adhesions.

ent to the right tube and ovary, or to the bladder or uterus, or the sigmoid flexure; or it may be entirely surrounded by the lower end of the omentum, which may hold it as though it were clasped in a closed hand. Wherever it may be it is certain

that it will be found at the end of the longitudinal band extending down over the cecum.

It is well to be prepared to encounter pus at any time after beginning the search for the appendix; consequently, it is best to have the immediate field of operation banked away by a further tampon of moist, sterilized gauze, and to have in readiness several other tampons with which it is possible to absorb pus as soon as it may appear. In this manner an abscess surrounding a perforated or gangrenous appendix may be evacuated without permitting the pus to touch any uninfected tissue, and one can virtually perform an aseptic operation in a case of suppurating appendicitis.

With increasing experience one is enabled to follow the appendix with the finger by the sense of touch, and separate it from the surrounding structures without any danger of injuring them.

After the appendix has been shelled out of its adhesions, the cavity in which it was contained usually bleeds quite freely, but the bleeding will cease spontaneously if a warm, moist, aseptic gauze tampon is packed into the cavity thus formed and left in place until the remaining steps of the operation have been completed. The appendix is now removed as in the previous case and the stump buried as before. It is, however, necessary to cover all the abraded surfaces with

peritoneum by means of fine catgut or silk sutures. If there has been no escape of pus the tampons are removed and the abdominal wound closed as before, but if pus was found it is usually best to insert drainage.

As a general thing it is better to make a second incision about one and a half inches above and to the inner side of the anterior superior spine of the ilium, less than an inch in length, being careful not to cut any of the muscle fibers, but to separate them after the method advised by McBurney, and to introduce through this opening a glass drainage tube a quarter of an inch in thickness, covered by two to four layers of iodoform gauze, long enough to extend to the bottom of the cavity from which the appendix has been removed. The abdominal wound is then closed in the manner already described. The glass drain is removed about the second day, and the gauze two days later. If there is purulent discharge through the drainage opening it is well to insert a small rubber drain after removing the gauze. If the method of exclusive rectal alimentation has been carried out through the acute attack, the bacteria contained in the abscess have usually been so much weakened that there is very little suppuration, and in such cases drainage appears to be quite superfluous. After the drainage is withdrawn the opening closes rapidly and permanently on account of

the arrangement of the muscle fibers, so that the drainage is at least a harmless safeguard even in

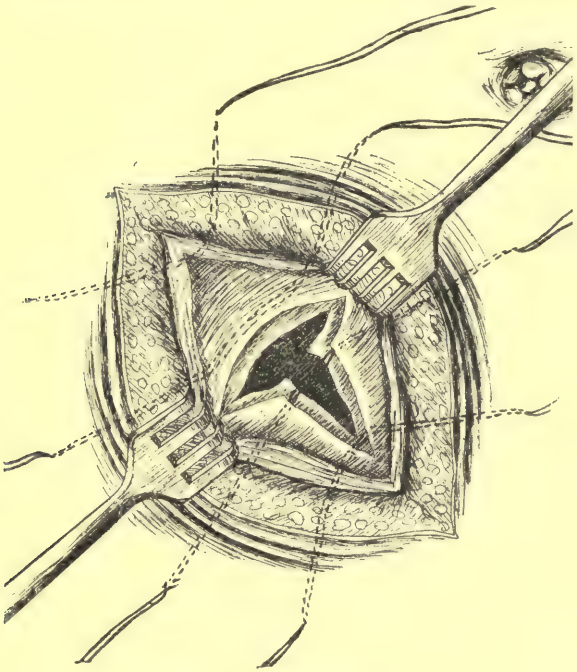


Fig. XIII. Showing incision through fibres of internal oblique muscle in order to gain space.

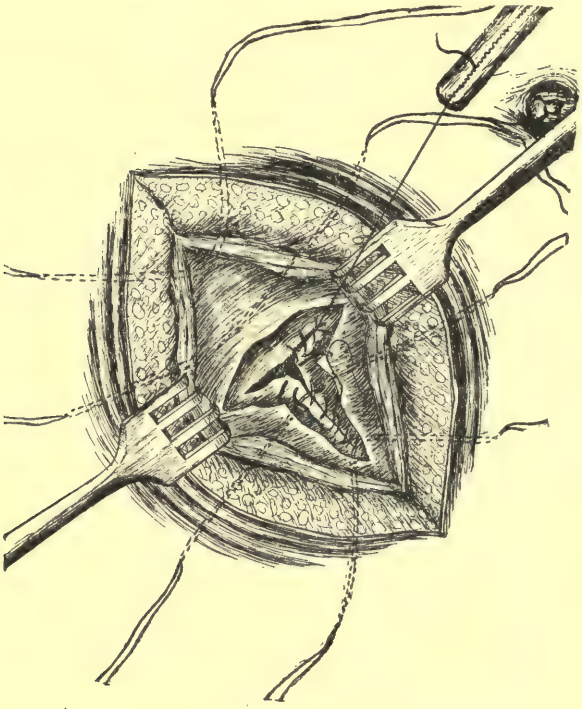
cases in which no danger might have come to the patient without it.

In case one has opened the abdominal cavity by means of McBurney's incision (Fig. I), and finds

that there is not a sufficient amount of space to expose all of the tissues involved, even after the outer sheath of the right rectus abdominis muscle has been opened according to the suggestion of Wier, it is occasionally necessary to make a transverse incision through the internal oblique abdominal muscle, transversalis fascia and peritoneum, as shown in Fig. XIII. Any desirable amount of space can be obtained in this manner and the wound thus formed can readily be closed by first suturing the peritoneum and the transversalis fascia, as shown in Fig. XIV; then the transverse incision in the internal oblique abdominal muscle, as shown in Fig. XV; then closing the wound as though this incision had not been made.

Of course, the same precautions are necessary to prevent the occurrence of infection in operating for the relief of appendicitis as in other operations, and it is a good rule to limit the number of hands which come in contact with the tissues as much as possible. In operations performed in well-regulated hospitals it is a comparatively easy matter to have all persons connected with the operation equally well trained as regards aseptic and antiseptic precautions, but if one is compelled to operate in a private residence with the aid of untrained assistants, the conditions are entirely different, and it is often necessary to make a less thorough operation in order not to run the

risk of losing the patient from septic infection. It is often best, under these conditions, simply to



FIV. XIV. Showing closure of wound in transversalis fascia and peritoneum by continuous suture.

drain the abscess surrounding the appendix by making an incision from one to two inches in length over the most prominent point, taking the

precaution to separate the muscle fibers rather than cut the muscle transversely, and simply in-

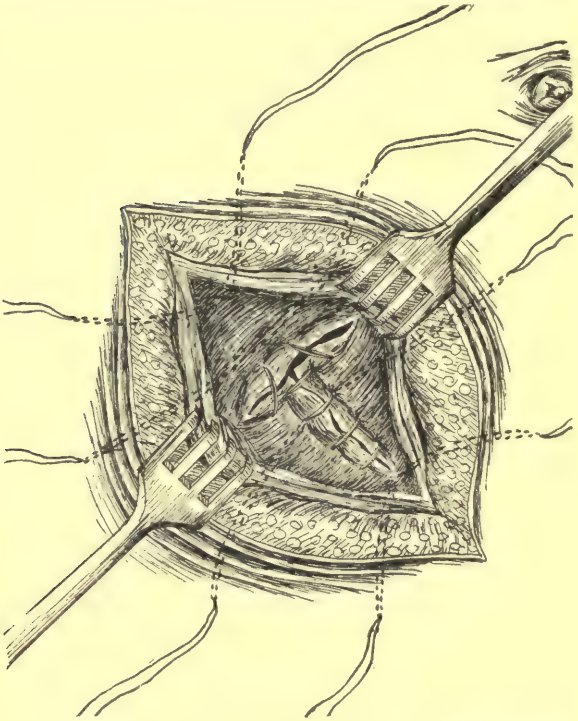


FIG. XV. Showing closure of wound in internal oblique muscle with interrupted suture.

serting one or two glass drainage tubes surrounded by a few layers of gauze, and applying over this a warm, moist, antiseptic dressing which will favor

the drainage of the cavity. Of course, after recovering from the acute attack such cases are liable to suffer from further disturbances. The extensive adhesions which are likely to form will interfere with the normal passage of gas and liquids through the alimentary canal, and will thus give rise to digestive disturbances. Chronic constipation is likely to result. The patient will probably suffer from gaseous distension of the intestines, and a recurrence of the acute attack is liable to occur at any time. At the point of drainage a ventral hernia is likely to appear; consequently, even this slight operation may be followed by very unsatisfactory results. In choosing between this form of treatment and the treatment by exclusive rectal alimentation, I am certain that the latter method has a much smaller mortality and leaves the patient in a better condition when the attack is ended, and, as a rule, the recovery is more speedy than with the simple incision and drainage.

CHAPTER IX.

AFTER-TREATMENT.

If the appendix has been removed before any of the septic material has invaded any tissues beyond the tissues of the appendix, at the beginning of an attack, or, if it has been removed during the interval between attacks, or, after an attack has entirely subsided, so that drainage was not employed, then the after treatment is extremely simple. Neither food nor cathartics are given by mouth for from three to seven days, according to the condition of the patient. He receives an ounce of one of the various reliable predigested foods, diluted with three ounces of normal salt solution, as an enema every four hours. Hot water in small sips is given by mouth at frequent intervals. If the patient is nauseated his pharynx is sprayed with a four per cent solution of cocain, and gastric lavage is employed, hot normal salt solution being used for this purpose. It is best to wait about four minutes after applying the cocain before inserting the stomach tube, in order to obtain fair anesthesia. A considerable amount of bile and mucus is occasionally found in the stomach, and its removal is immediately followed

by great comfort to the patient and a cessation of nausea and vomiting. It is but very seldom that these patients suffer sufficiently to require narcotics, but in case of necessity morphin in moderate doses can be given with perfect safety so long as no food is given by mouth.

The after treatment in these cases is in no way different from that employed in cases of abdominal section performed for any other pathological condition. As a general rule I believe that the less one meddles with these cases the more smoothly does their convalescence progress.

After five or six days a mild saline laxative or an ounce of castor oil may be given, if it seems indicated.

Two days after the operation or later, if the patient's digestion seems to be upset, small quantities of liquid nourishment are given every three hours. Usually it is well to begin with a placebo in the form of one of the commercial beef extracts. Later on this may be changed to broths, gruels, strained soups, milk and lime water or to one of the many excellent concentrated foods found in the market. I do not usually give solid food until two weeks after the operation. The stitches are removed from the tenth to the fifteenth day and then a broad adhesive plaster is applied to support the wound.

If McBurney's incision has been employed in

any case, it is perfectly safe for the patient to leave the bed after two weeks. But if the incision was made through the rectus abdominis muscle or through the linea alba, it seems wise to confine the patient to his bed for one week longer.

In case the wound has been drained, a fresh moist dressing is applied once a day to favor drainage. Any mild antiseptic solution may be used; I have found a saturated solution of boric acid very satisfactory. As soon as the amount of discharge becomes greatly reduced the drainage tube with its surrounding iodoform gauze may be removed and a small rubber tube substituted. If the wound has been left wide open, some of the secondary stitches may be tied at this time, which has a tendency to reduce the likelihood of the formation of a ventral hernia.

No definite time can be given for the removal of the drainage because this depends upon the conditions present in each individual case; but as a general rule, it may be stated that the sooner the drainage is removed the less danger will there be of the formation of a ventral hernia.

In this class of cases it is well to continue the exclusive rectal alimentation longer than in the clean cases because there is much greater opportunity of harm coming from the peristalsis which must ensue upon the administration of food by mouth.

In case of fecal fistula, it is best to continue the exclusive rectal feeding for a sufficient time to permit the fistula to close, which usually occurs within two weeks if the appendix has been removed, but if this has not been done a secondary operation will frequently be required, because in these cases the opening is usually in the appendix. The mucous lining of this organ shows a tendency to become everted on account of its strong layer of circular muscle fibers. In this manner the opposing surfaces in the fistula are covered with mucous membrane which prevents union.

The cases in which the appendix cannot be removed when the appendiceal abscess is opened and drained become less and less numerous as the surgeon's experience and skill increase. These cases frequently acquire ventral herniae within the first year after the operation. In order to prevent the formation of troublesome ventral herniae in these cases, it is well to apply the gauze employed in drainage so that the cecum becomes adherent throughout to the wound. If this is done a weak point in the abdominal wall will give rise to very little discomfort. It is only when the small intestines become engaged in a ventral hernia that the latter becomes troublesome.

Not a few of these cases have a recurrence of appendicitis in the same time. The latter condition can, however, usually be prevented if the

patient's diet is carefully selected. The food should be easily digestible, plain and nourishing. The patient should be especially cautioned never to eat heartily of solid food when tired. He should never eat quite enough.

He should never suffer from constipation. I have observed many of these patients who could protect themselves absolutely against a recurrence by observing these simple precautions, but who could bring about a recurrence with great regularity by neglecting them.

It is usually best to advise an operation for the relief of a ventral hernia in these cases because the diseased appendix can be removed safely at the same time, thus preventing the possibility of a recurrence of appendicitis.

OPERATION FOR THE RELIEF OF HERNIA FOLLOWING APPENDICITIS OPERATIONS.

The herniae in these cases result from the stretching of scar-tissue developed between the edges of the anatomical structures which have been divided, because primary union has been prevented by the presence of the drainage, or on account of infection or because the various layers were not originally united with sufficient accuracy.

The operation for the relief of this condition must consequently consist in the removal of this cicatricial tissue in order to expose all of the anatomical layers, securing a condition very similar

to that present at the time the wound was first made, as illustrated above. Then the wound is closed precisely after the manner described in connection with the operations in which drainage is not required. It is remarkable how easily these layers can be dissected out even after a hernia has existed for a number of years.

Experience has shown that when this operation has been performed carefully and aseptically the results are practically always permanent.

The location of the original incision in any given case will determine the character of the operation for hernia following an appendicitis operation.

If in the original operation all the muscle fibers were split longitudinally there may be a considerable amount of separation, but there can be no real retraction of the edges. It is quite different when the muscle fibers have been cut transversely. The former condition is true in all cases in which the incision has been made through the linea alba or through the edge of the rectus abdominis muscle or by splitting the fibers of both the internal and external oblique according to the incision advised by McBurney.

In case a hernia follows any one of these incisions it is extremely easy to find the edges of these muscles even if they are widely separated and then to apply the stitches as shown in Figs. VII to XI.

If, however, one or more of the abdominal muscles have been cut transversely, the ends may have retracted a great distance and it may require a tedious and careful dissection, and after this has been completed it is often difficult to obtain a satisfactory union between the severed ends.

Fortunately most surgeons who undertake these operations at the present time are careful to avoid cutting any of the abdominal muscles transversely. It seems that the incisions indicated in Figs. I and II are so satisfactory and provide for every possible necessity so completely that they should be generally practised, and this will not only to a great extent eliminate ventral hernia but will also facilitate their closure should they occasionally occur notwithstanding this precaution.

CHAPTER X.

COMPLICATIONS OF APPENDICITIS.

As our experience increases in the surgical treatment of appendicitis especially, it becomes clear that many complications which at first seemed to be very rare, are really quite common, but that these were either overlooked formerly, or that they were recognized while the appendicitis was overlooked. This latter condition is true especially of the most common complication of appendicitis—the involvement of the pelvic organs of the female.

Until very recently almost all authors have agreed that appendicitis is more common in the male than in the female, but it seems clear that this opinion is based upon the fact that until very recently a large proportion of the cases of appendicitis in the female were diagnosed as salpingitis.

In many of these cases, two conditions have tended especially to confirm this error. During an attack of perforative or gangrenous appendicitis with quite extensive peritonitis the ovaries and tubes may become infected secondarily. The fimbriated extremities of the tubes may become adherent to the ovaries or to each other or to the floor of the pelvis, or the lumen of the Fallopian tube may become partly or wholly obstructed

either by destruction of a part of the mucous membrane lining it or by an acute flexion due to external adhesions; consequently when an abdominal section is performed these pathological conditions will be found and attributed frequently to an ascending infection from the uterine cavity, and the true source of infection in the appendix having subsided, the pathological changes which still remain in the latter organ are overlooked.

For a number of years I have examined the appendix in all patients suffering from an inflammation of the ovaries and tubes or from adhesions of the latter due to a severe inflammation which had already subsided, and in a considerable proportion of these cases I have found unmistakable evidences of the fact that at some previous time the patient had suffered from perforative or gangrenous appendicitis. In my experience, approximately 30 per cent of all cases of perforative or gangrenous appendicitis in the female have a secondary involvement of the right ovary and tube.

Many of these cases have a slight attack of recurrent appendicitis during each menstrual period. The congestion accompanying menstruation seems to suffice to bring about a recurrence of varying severity. This fact has been the cause of many mistakes in diagnosis, because it seemed to refer the disease to the pelvic organs.

Most of these cases give the history of having had a peritonitis at some time more or less remote, frequently during childhood, and after this time there has constantly been some trouble in the right iliac region which has usually been exaggerated during the menstrual period. A right sided dysmenorrhea should always direct suspicion toward the vermiform appendix.

Sterility.—Many of these patients, especially those who experienced a perforative or gangrenous appendicitis in childhood with an extensive peritonitis severely involving the pelvic organs, never recover sufficiently from the adhesions formed at this time to transmit the ovum to the uterus and consequently the patient remains permanently sterile. It seems as though this fact should have some influence in determining the treatment of acute appendicitis in the female.

Ovarian Cysts.—In a considerable proportion of patients suffering from ovarian cysts there has been, usually at some remote time, a perforative or gangrenous appendicitis, as is shown by the systematic examination of the appendix in these cases. It is possible that this is simply a coincidence, but it is also possible if not probable that the connective tissue formed upon the serous covering of the ovary resulting from its infection during the attack of appendicitis may have given rise to

the closure of the Graafian follicles and their distention with fluid, forming the ovarian cyst.

Gall Stones.—For several years I have systematically examined the appendix in all cases upon which I have operated for the relief of gall stones, and have found that 35 per cent of these have suffered also from appendicitis.

This again may be a coincidence, or the same infection from the alimentary canal which primarily caused the appendicitis may have caused the cholecystitis, which produced the gall stones; or it is possible that the infection was primarily located in the appendix and that from this depot of infection the micro-organisms were carried to the gall bladder and there gave rise to the conditions necessary for the development of gall stones.

The fact that the two conditions occur so frequently in the same patient has a practical bearing. In case both conditions are present and only one of these is relieved by the operation, the patient will still continue to suffer.

It is consequently best in cases in which the history or the physical examination points to both of these conditions to make the incision at the time of the operation in a position which will permit the examination and treatment of both of these organs. Fig. 1 indicates the location of this incision.

Strangulated Hernia.—A considerable number of cases of acute appendicitis complicating strangulated hernia have been reported. I have encountered gangrenous appendices, both in strangulated femoral and inguinal herniæ and in one case of irreducible umbilical hernia.

I have also operated upon one case of inguinal hernia which was complicated with suppurative epididymitis and orchitis, together with an acute suppurative appendicitis in a case of cryptorchism.

In this case the cecum was so low that by lengthening the herniotomy incision upwards by dilatation it was possible to remove the appendix through this opening. An orchidectomy was performed, the wound was drained and tamponed with iodoform gauze for a week, then it was sutured secondarily. The result was perfect.

Typhoid Fever.—In cities where typhoid fever is endemic, it is not a very uncommon occurrence to find difficulty in making a differential diagnosis between typhoid fever and a mild attack of appendicitis or between the presence of a perforative appendicitis and a perforative typhoid ulcer.

In four instances I have observed patients suffering from plainly marked attacks of acute appendicitis in which a typical attack of typhoid fever followed immediately. In each of these cases the patient had consumed great quantities of infected water during the beginning of his sick-

ness. The fever accompanying the appendicitis caused severe thirst and the great quantity of water containing typhoid bacilli consumed during the time had brought about the typhoid infection.

I have, of course, seen many cases of simple appendicitis which had been diagnosed typhoid fever and vice versa, but the cases referred to above did not belong to this class.

Since the introduction of the Widal test it is, of course, much easier in difficult cases to make a positive differential diagnosis. In locations, especially in great cities, in which a large proportion of the population regularly drinks unsterilized water infected with typhoid bacilli, it is wise to bear in mind the fact that typhoid fever and appendicitis may occur at the same time in the same patient. Of course, the same thing might happen by accident with almost all of the other intra-abdominal conditions.

I have personally encountered a renal calculus, an extra-uterine pregnancy, a gastric ulcer as well as all the varieties of tumors occurring in the uterus and adnexa in connection with acute appendicitis. It is likely that in each case the fact was due simply to a coincidence and that no causal relation existed between the two conditions.

Floating Kidney.—The presence of an abnormal mobility of the right kidney, either with or without general enteroptosis is not at all uncommonly

found in connection with chronic recurrent appendicitis. It is possible that the increased intra-abdominal pressure which has to be employed in these cases to overcome the obstruction to the passage of gas and feces through the ileocecal valve may be responsible for the mobility of the kidney, or it may simply be a coincidence.

In many of these cases there are extensive adhesions which interfere seriously with the fecal circulation causing the intestines and the stomach to be constantly distended with gas, and this may help to account for the mobility of the kidney.

Thrombophlebitis.—Occasionally in cases of appendicitis which have not been operated, and more frequently following operation there is a thrombophlebitis of the external iliac vein. Ordinarily the condition does not interfere with the recovery materially. The same precautions should, however, be employed as in a thrombophlebitis from any other cause. If a small portion of the thrombus is displaced, it is likely to cause serious trouble and may give rise to thrombosis of the pulmonary artery, causing sudden death.

Metastatic Infection.—Occasionally acute appendicitis is followed by metastatic infection. This may occur in any part of the body. I have myself encountered it in the gall bladder, the liver, the pleural cavity, the parotid gland, the meninges, the endocardium and in several joints.

These conditions must be met precisely as though the primary infection had been in any other part of the body.

This small monograph is based upon an experience of over one thousand cases of appendicitis upon which I have operated myself besides a large number of cases, which I have treated through the acute attack without operation either in person or in consultation with colleagues, and upon the careful study of the literature which is so voluminous that this addition seems quite superfluous.

In conclusion I will say that the most important lesson my experience has taught me is the fact that *more harm is done to the patient suffering from acute appendicitis by the administration of any kind of nourishment or cathartics by mouth than in any other way, and that more lives can be saved by prohibiting this and by removing any food which may be in the stomach at the beginning of the attack by gastric lavage than by all the other methods of medical and surgical treatment combined.*

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INDEX.

ABSCESS, circumscribed, formation of, 100
drainage of, 128, 154
opening of, 12, 93
Actinomycosis, of Appendix, 40
Acute appendicitis, symptoms of, 66
Adherent appendix, illustration of, Fig. XII, 152
After-treatment, 160
food in, 160-161
gastric lavage, 160
in drainage cases, 162
laxatives, 161
morphine, 161
of fecal fistula, 163
Age, 34
Albers, 12
Allingham, 74
Appendicitis, classification of, 44
complications of, 163-174
differential diagnosis, 81
history of, 9
in children, 44
Appendiculo-ovarian ligament, 20
Appendix, abnormal position, 17
adhesions of, 17
anatomy of, 15, 21, 22, 99
blood supply of, 20, 21
guide to, 18
nerve supply of, 22
normal condition of, 15
position of, 15, 16
structure of, 23, 25

BACTERIOLOGY, 40, 43
Barnsby, 85
Bernardbeig, 85
Bibliography, 175
Biliary colic, differential diagnosis of, 83
Boat shaped abdomen, 76
Borchardt, 85
Bottomley, 12
Brooks, 85
Bryant, 20, 22
Burne, 12

CATARRHAL APPENDICITIS, 45
Cathartics, contra-indicated, 121

Cecum, longitudinal band, illustration of, Fig. IV, 138
mobility of, 17
obstruction of, 17, 28
peritoneal covering of, 16
position of, 16
Chronic appendicitis, obstruction to gas in, 17
symptoms of, 77
Clado, 20, 21
Clamping appendix, illustration of, Fig. V, 139
Classification, 44
Coe, 86
Complications of appendicitis, 163-174
Constipation as a symptom, 79
Contraction of abdominal muscles as a symptom, 75
Copeland, 11
Costal respiration as a symptom, 76
Crutcher, 86
Cushing, 34

DAWBARN, 140
Deaver, 14, 16, 40, 63, 64, 85
Delageniere, 85
Dieulafoy, 14
Differential diagnosis, 81
Digestive disturbances as a symptom, 27, 64, 79
Disease primarily in appendix, 14
Drainage, method of, 154
Dupuytren, 11, 13
Dysmenorrhea, 86, 87

EARLY operation, reasons for, 126
Edebohls, 79
Enteritis, differential diagnosis of, 82
Enteroptosis, causes of, 17
Etiology, 25
External oblique muscle, illustration of suture of, Fig. VIII, 143
Extra-uterine pregnancy, differential diagnosis of, 87

FACIAL expression as a symptom, 74
Fecal concretion as a cause, 31
Fecal fistula, treatment of, 163
Fenger, 60
Ferguson, 9
Ferrall, 11
Fitz, 10, 11, 95
Flexion of right thigh as a symptom, 76
Flint, 23

Floating kidney as complication, 172
Food, as cause of extension of infection, 100
in after-treatment, 160
reason for prohibiting, 106
Foreign bodies as a cause, 31
Fowler, 14, 17, 47, 55, 84

GALL-STONES as a complication, 169
Gall stone colic, differential diagnosis of, 83
Gangrene, cause of, 21, 50
Gangrene of the mucous membrane, 49
Gas in appendix, 33
Gastric lavage, 69, 105
Gastritis, differential diagnosis of, 82
Grisolle, 11

HAWKINS, 9, 16, 60, 122
Hernia following operation, 163
operation for, 164
prevention of, 154
History of appendicitis, 9

INCISION, 131
median, 146
McBurney, 131
through rectus abdominis muscle, 143
Indiscretion in diet as cause of, 28, 29, 34
Infection of peritoneal cavity, 56
Inflamed appendix, elimination of, 99, 108
omentum in, 115
Internal oblique muscle, illustration of uniting, Fig. VII, 142
Intussusception, differential diagnosis of, 89
Irritability of bladder as a symptom, 76

JADELOT, 12
Josue, 57

KEEN, 10
Krueger, 85

LANGE, 63
Laxatives, contra-indicated, 121
Leeches in treatment, 97
Lennander, 14, 17, 86
Leucocytosis as a symptom, 77.
Leudet, 13
Lewis, 12
Lockwood, 20
Luschka, 16

MAYO, 17
McBurney, 10, 108, 131
McBurney's incision, illustration of, Fig. III A, 134; Fig. III B, 135
enlargement of, Fig. XIII, 155
Melier, 12
Menstruation, as exciting cause, 74, 168
Meso-appendix, 21, 22, 51
Mestivier, 11
Metastatic infection as a complication, 173
Morris, 14, 23, 43, 136
Murphy, 10, 44
Muscles of abdomen in relation to incision, Fig. II, 133
Mynter, 14, 39, 116

NAUSEA and vomiting as symptoms, 68
cause of, 68
treatment of, 104
Non-operative treatment, 91
Nutrient enemata, administration of, 104

OMENTUM, function of, 100
Operation, preparation for, 130
reasons for, 125
time of, 114, 126, 130
Opium, contra-indication of, 96
treatment, theory of, 95
Osler, 95

PAIN, 66
cause of, 106
character of, 67
localization of, 67
location of, 66
Pepper, 95
Perforation of appendix, history of, 11
involvement of Fallopian tube in, 166
treatment of, 102
Perforative gastric ulcer, differential diagnosis of, 82
Perforative intestinal ulcers, differential diagnosis of, 88
Peristalsis of intestine, 100
Peritonitis, appendiceal origin, 58
general, prevention of, 102
tubal origin, differential diagnosis of, 83
Peritoneal fossæ, 20
Polle, 85
Predisposing causes, 34
Price, 10

Pulse as a symptom, 72
Purse-string suture, illustration of, Fig. V, 139

RECTAL alimentation, 104, 111.
Recurrent appendicitis, causes of, 36, 37
prevention of, 129, 164
Renal colic, 88
Ribbert, 35
Richardson, 9, 10, 77, 114, 117
Richelot, 86
Rigidity of abdominal muscles as a symptom, 69
Roger, 57
Rokitanski, 10, 13
Rolleston, 20

SAHLI, 71
Saline cathartics, 96
Senn, 59
Sex, 30, 167
Simple catarrhal appendicitis, 45
Sonnenburg, 14, 85
Special cases, 37, 40, 41, 53, 61, 77, 108, 109, 113, 119, 170
Sterility from appendicitis, 168
Strangulated hernia as complication, 170
differential diagnosis of, 89
Stump of appendix, illustration of burying, Fig. VI, 141
Swelling as a symptom, 70
Symptoms, 66

TALAMON, 32, 59
Temperature as a symptom, 71
Tenderness as a symptom, 68
Thrombophlebitis as a complication, 172
Tongue, condition of as a symptom, 72
Treatment, non-operative, 91
cathartics in, 121, 122
cold applications in, 97
food in, 100, 106
gastric lavage in, 105
hot applications in, 97
leeches in, 97
methods of, 95
nutrient enemata in, 104, 111
opium in, 95, 96
of pain in, 106
water in, 104

Treatment, operative, 125
preparation for, 130
reasons for, 125
time of, 114, 126, 130
Treves, 15
Tympanitis as a symptom, 73
Typhlitis, 13
Typhoid bacilli as cause, 41
Typhoid fever as complication, 171

ULCERATION as a cause, 31
Ulceration of the mucous membrane, 46
Ulceration with perforation, 48

VAUTRIM, 86
Ventral hernia, cause of, 163
operation for, 164
Vomiting as a symptom, 68
cause of, 68
treatment of, 104
Voltz, 13, 95
Volvulus, differential diagnosis of, 89

WALLIS, 9
Wegeler, 12
Weir, 10, 136
With, 13

ZIEGLER, 39, 55

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